THE

ELECTRICAL REVIEW.

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THE POSTAL TELEGRAPHISTS.

Media simillima vera sunt is as true a saying at the present day as it ever was; but out of a chaos of statements, counter-statements, and mis-statements, it is extremely difficult to say where the truth, or rather the approximate truth, lies. The recent difference between the telegraphists and the Postal authorities is in many respects a chaos, due largely to mis-statements caused by a want of proper advocacy on the part of the telegraphists. The result of this is that the whole case is suggestive of the Irishism "we don't know what we want, but we are determined to have it." First let us assert our belief that any idea that the higher officials who have had to deal with the late agitation, had not intended to mete out strict justice, cannot be entertained for a moment; the whole case has been a most difficult one to deal with, and the resulting failure (if it can be called such) of the malcontents has, we believe, been very largely due to a misunderstanding of the position of affairs, a misunderstanding brought about, as we have said, largely in consequence of a want of proper advocacy on the part of the telegraphists themselves. The failure also may have been due to the case presented not having been so strong in fact as has been imagined. It is not at all surprising that those smarting under the sense of defeat should be so greatly annoyed as to speak or write of the matter with undue warmth, and full allowance ought to be made when criticising the utterances of those suffering from the sting of severe disappointment. Our Belfast correspondent "Telegraph," whose letter we published in our last issue, has doubtless many arguments on the subject which have considerable weight, but at the same time many of his assertions may apply with equal force if made use of by the opposing side. Such an expression, for instance, as "determined manner in which they ignore plain facts," might be used by the authorities in defending their case against the telegraphists. It is an extremely difficult matter for an outsider to get at "plain facts" in a complicated condition like that under consideration, chiefly in consequence of the fact that many of the points which materially affect the whole question are official ones, which though not advisedly kept secret from the public are at the same time not publicly known. As our desire is neither on the one hand to defend the authorities, nor on the other hand to minimise the claims of the telegraphists, but simply to enable the truth of the whole affair to be brought out and thereby if possible to secure peace, it seems to us that this might be helped along by putting a few questions to which we would invite our correspondents' replies. It is stated by "Telegraph" that the telegraphists are not asking "an increase of the maximum salary from £160 to £190," but that "the maximum of £190 granted to them by Mr. Fawcett in 1881 may still be given to them." This we take to mean that a telegraphist could prior to the issue of the Tweedmouth Commission report have been able to rise

up to £190 a year from a minimum salary of, say, £80, by a yearly increment, without a bar or pause of any kind, and that a bar was introduced by the Tweedmouth Commission which stopped promotion at £160 but allowed it to continue up to £190 on condition that a technical examination was passed. Now if this is so, it should be asked (and this point "Telegraph" has not thought fit to take notice of though we specially alluded to it in our leader) was the technical examination such as to practically act as an insuperable barrier to a large number of men. In fact, can "Telegraph," or any other correspondent, state cases in which men of "25 or 30 years' service" and of average value as telegraphists, have actually been hopelessly stopped at the £160 limit in consequence of their being unable to "answer such questions." We are not in a position to say, but we cannot believe, that the authorities in conducting the examinations would not make some allowance for the fact that a man of long service, who entered before technical examinations were thought of, might in consequence of his advanced age be unable to learn up technical matters.

We should like one of our correspondents to quote chapter and verse supporting the contention that Mr. Fawcett, in 1881, granted a maximum of £190, free of all barriers of any kind, and also the contention that the maximum has been reduced of recent years to £160. In other words, do the Parliamentary estimates of, say, 1882, show something like the following:—Scale of pay: telegraphists, minimum £80, rising by £5 a year to maximum £190? And does this now stand: telegraphists, minimum £80, rising by £5 a year to maximum £160?

Whilst we cannot withhold sympathy with those who are striving to better their position and prospects by legitimate means and logical arguments, we must protest against the absurd exaggerations and side issues which are brought forward as arguments, and which do infinitely more harm than good. The "awful blundering" which "Telegraph" speaks of has no bearing whatever upon the point under discussion, except to prove that the whole Government system of the country is rotten, in which case the outlook of obtaining justice for the telegraphists by reform is not a particularly brilliant one. With regard to exaggeration, we cannot imagine anything more absurd than the contention that "telegraphy is distinctly a language, as difficult to learn as, say, French." Telegraphy is not a language but only an alphabet; the language has been already acquired, and is expressed only in characters differing from the ordinary alphabet. To compare it to learning French is the height of absurdity, for in the latter case there is a new *language* to learn, not a mere alphabet. To learn to translate "Morse" would require perhaps half a day or a day from an intelligent student, to translate French would take—well, something longer than this period we imagine. Underestimating the importance of one's work (which we contended, and still contend, the telegraphists have in one respect done) is one thing, to absurdly exaggerate that importance is another and a very foolish one. We trust that a way will yet be found to secure an amicable settlement of a long standing dispute, and with this object we again invite a thorough discussion of the whole subject, but in doing so we would remind our correspondents that neither abuse nor simple assertions are arguments, and that plain facts and not generalities are what is required.

The Transmission of Light Through Space.

An experiment has recently been made in America by Francke L. Woodward, which if confirmed by other experimenters will revolutionise all our ideas of the transmission of light through space. Woodward's experiment seems to indicate that light in its ordinary terrestrial form cannot be transmitted through a vacuum. An exhausted glass bulb was covered with black paper in which three circular openings were cut, two at opposite ends of a diameter, and the third at one end of a diameter at right angles to the first. A beam of lime light was sent across the vacuum bulb through the first two openings. On viewing the interior of the bulb through the third opening, the beam in crossing the interior vacuum was almost imperceptible. The intensity of the light issuing from the second opening was not one-twentieth of that entering by the first opening, and the more perfect the vacuum, the less was the intensity of the light issuing from the second opening. It would seem from this that if the vacuum were perfect no light would emerge from the second opening. If, now, a powerfully excited Crookes' tube is focussed on the bulb when the same experiment is performed, it will be found that the beam of light emerging at the second opening will have almost the same intensity as when it enters at the first. When the experiment was repeated with tubes of different degrees of exhaustion, it was found the intensity of the emerging beam of light was inversely as the degree of exhaustion, except when the Röntgen rays were focussed upon the vacuum tube. Woodward thinks that this supports Tesla's theory that the Röntgen rays consist of a stream of material particles capable of passing through the glass walls of the bulb. When these particles enter the bulb the transmission of light is facilitated. It would follow from this that light can only be transmitted when material particles as well as ether are present. Woodward gets over the difficulty of transmitting light through empty space, as for example from the sun to the earth's atmosphere, by supposing that the radiant energy is projected from the sun in the form of cathode rays which when they impinge against our atmosphere are converted into ordinary light. It must be admitted that we have no right to assume that light as we examine it in our laboratories, has the same form throughout the presumably empty space between the sun and our atmosphere. This altogether unjustifiable assumption has hitherto been made by physicists no doubt as being the most probable view to adopt, but in case the Woodward experiment is confirmed and a vacuum is proved to be opaque to ordinary light, our theories of the transmission of light through space will have to be changed. There are some astronomical and meteorological phenomena which support the theory of the existences of a cathode stream from the sun. According to the theory of comets which is now most in favour tails of comets are due to a cathode stream such as Crookes found to proceed from an obstruction placed in the main cathode stream. The aurora borealis has also been explained by Birkeland in a very satisfactory way on the assumption that it consists of cathode streams in the upper regions of the atmosphere, directed and controlled by the earth's magnetism. The cathode ray theory of the transmission of light will have many difficulties to meet, but it deserves to be thoroughly investigated. It looks as if, after all, there may have been more truth in the corpuscular theory of Sir Isaac Newton than we have hitherto dreamt of.

Electric Power Transmission. — The Zeitz Iron Foundry and Engineering Company, of Zeitz, has decided to operate all its machinery by electricity, and has given a contract for the supply and erection of a large electric power transmission plant to the Schumann Electrical Company, of Leipzig.

THE APPLICATION OF ELECTRICITY TO STEAM RAILROADS.

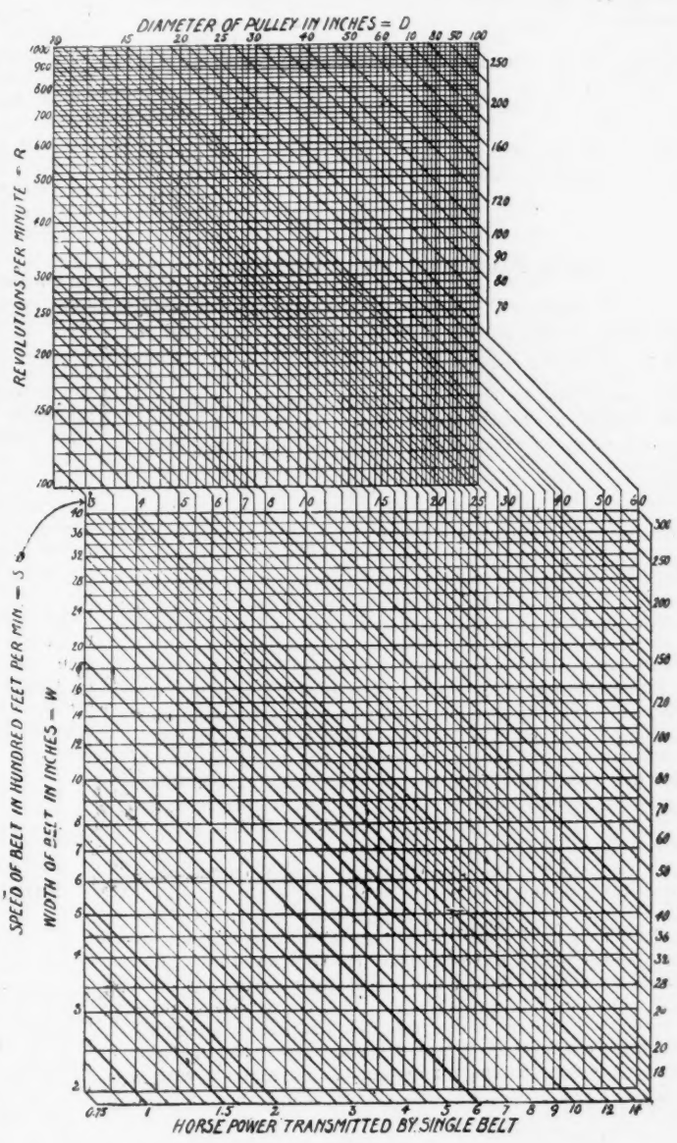
If we look round our English railways, we see that one line only, the London and Brighton, indulges in little locomotives and builds really light rolling stock. These light carriages are quite good enough for suburban traffic, and so are the small locomotives, and if the company only saw fit to put in windows that did not rattle so badly, the public would not complain. Other lines run their suburban traffic with large and heavy engines, larger and heavier than there is any occasion to employ. American railroads do the same, but American lines have not yet found out there is a suburban service, and such as they have had has largely gone from them to the electric lines which have so largely paralleled the steam roads.

A Mr. Brangs tells the Convention of Master Mechanics that they do wrong to use big locomotives and tenders, of which only half the load is available for adhesion. They ought to use an electric engine of half the weight all available. This, of course, is what they do with steam engines on the Brighton line, with their little tank engines, for comparatively slow-speed trains. To enable the competition of the electric lines to be met, Mr. Brangs would equip two of the four tracks which many of the steam lines have for a distance outside the principal cities, and he would run frequent two and three-car trains. He would also equip many of the short branch lines with electrical cars as feeders to the main lines, as we have ourselves suggested might be advantageously done with some of the branch lines in England.

The question is largely one of labour cost. Given a branch line from a certain trunk station the traffic on this must amount to at least the use of one locomotive employing two men. One man could both drive and fire at the central station supplying current to work this branch electrically, and there would be one man on the train in place of three. Electricity would halve the labour. Given a traffic on the branch sufficient to keep two trains running, and only three men would still be required electrically as against six men with steam locomotives. With three trains four men would replace nine. But very often two or more branch lines are run from a main line station, and one set of plant with the minimum of attendance would work these branch lines, and the employment of three men and a long train to carry a couple of old market women, as now sometimes seen, would be obviated. One motor man would be sufficient to act as driver, stoker and guard to the old dames as well. Mr. Brangs enters into the worn theme of coal consumption by locomotives, with a view to showing how much more economical electric traction may be made at a carefully tended central station, for unlike the locomotive, the electromotor is not dependent on its driver's skill for its efficiency, whereas the steam engine does, and economy can be better attained in stationary work than on a locomotive. The question of the now badly served branch lines is one to which railway directors might well direct attention, and endeavour by more frequent journeys of a single car to develop traffic which is latent, or secure traffic that now goes by road in the private trap, the cart, or the multitudinous bicycle.

HORSE-POWER DIAGRAM FOR BELTS.

The accompanying diagram, for which we are indebted to the *American Machinist*, seems to be so convenient, that we publish it for the benefit of our readers. There are so many factors in belt calculation, that an error is easily liable to be made. The diagram is drawn for single belting, and from the result obtained the particulars can be easily deduced for double belting by suitable factor of exchange. There are four factors in belt design, viz., pulley diameter, revolutions per minute, breadth and horse-power transmitted. All these are suitably co-related in the diagram, and our contemporary thus describes the method of using the diagram, taking a concrete example wherewith to illustrate same. "The size of pulley is, say, 40 inches; it runs at 200 revolutions per minute, and 10 horse-power is to be transmitted. How wide must the belt be? At the extreme top of the diagram is a row of figures standing for pulley diameters, and taking 40 (the diameter of the pulley in this case) follow the vertical


DIAMETER OF PULLEY IN INCHES = D
REVOLUTIONS PER MINUTE = R
SPEED OF BELT IN HUNDRED FEET PER MIN. = S
WIDTH OF BELT IN INCHES = W
HORSE POWER TRANSMITTED BY SINGLE BELT

line designated 40 down to its intersection with the horizontal line which is designated at the left 200 (which number represents the number of revolutions per minute): from this point of intersection follow the line diagonally downward and to the right to the line of figures representing belt speed in hundreds of feet per minute. This is nearly 2,100 feet. This last figure is not needed in this instance, but the diagram shows what it is, and it costs nothing to note the speed. From this point follow vertically downward to the intersection of the diagonal line representing 10 horse-power (numbered at the bottom of the diagram), and the figure at the left of this point of intersection shows that the belt must be 4 inches wide."

The rules for belting are numerous, and most practical

men use them with discretion, and do not calculate specially upon the basis of the arc of embrace, but rather allow for this by experience. One belt maker's rule for double belt is $H = \frac{80 \; W \; V}{33{,}000}$, where H is the indicated horse-power, W is the width in inches, and V is the velocity in feet per minute.

Calvert's rule was $W = \frac{33{,}000 \; H}{6 \; V \; L}$, where L was the length of the belt arc on the smaller pulley.

Evan Leigh's rule was $H = \frac{A \; V}{66{,}000}$, where A was the area in square inches of belt contact on small pulley.

Both these rules took note of the arc of contact or embrace. Another rule for double belting is to allow 30 square feet area of belting to pass a given point per minute for each horse-power transmitted. We have found satisfactory driving in the following actual examples. Two 36-inch belts, run at 4,526 feet velocity per minute, drove 1,300 H.P.

An indicated horse-power of 400 was carried by a 35-inch belt in Halifax at a speed of 3,889 feet. In Brighouse a 21-inch belt at 3,020 feet drove 180 I.H.P. Two 30-inch belts at 3,020 feet carried 500 H.P.

GAS ENGINES IN AMERICA.

When we speak of the gas engine as so very modern we are apt to forget that it is not really so, and in a paper read to an American engineering society, Mr W. F. Kelly reviews the history of the gas engine and instances its early forms. It appears that as far back as 1680 Huygens proposed a gas engine worked by gunpowder. In 1690 Papin continued Huygens' experiments, and in 1794 one Streets made a turpentine engine. The oil engine thus was earlier as a real engine than the actual gas engine. Brown, in 1823, retrograded in using a flame to produce a vacuum. This was rather a fire engine. It did work, however—drove a boat on the Thames and a carriage in the streets of London. Wright, in 1833, made a double-acting water-jacketted engine working with an explosive mixture of gas and air, and this engine was improved upon by Barnett in 1838 who used compression and ignited on the centre, a point from which no really successful engine has ever erred. Red hot tube ignition was added by one Newton in 1855, and in 1855 Barsanti and Matteuci brought the gun type with rack piston rod and clutch, afterwards made a success by better workmanship by Otto and Langen. But to Lenoir is due the first really public engine. It was as nearly like a steam engine as possible, and in 1865 in Paris, there were in use 300 or 400, while the Reading Ironworks made 100, some of which are said to be yet in good condition.

It was in 1867 that the Otto and Langen engine came out. Brayton's engine dates to 1873 and the modern Otto to 1876, or 31 years ago. It is said there were 35,000 gas engines used in England in the year 1894, while there are as many as 85,000 in Germany. In German towns, like Hanover, Erfurt, Berlin, and the Saxony towns, gas costs from 4s. to 5s. 6d. per thousand. This seems a high price and unless balanced by dear coal would appear to be against the large employment of gas engines. Yet in Saxony there is a gas engine to every 200 people. In America coal is cheap and gas is dear, and gas engines also are dear, and we believe do not compare in excellence of manufacture with the native steam engines. American steam boilers are also cheap and are allowed very high working pressures. Still there are now some 50 firms who make gas engines, some up to 100 H.P. Still, on the whole, there is a distrust of the gas engine, and there is, of course, a prohibitive import duty on European engines, so that Americans have not much chance of seeing what really good gas engines can do.

ISOLATED PLANTS VERSUS CENTRAL STATIONS.

Some useful data has been published by Mr. Percival R. Moses in the *Engineering Magazine* which show for various classes of building the difference in working cost as between buying light from outside companies and manufacturing it on the premises. The buildings selected are hotels, apartment houses, office buildings, restaurants and clubs, and, finally, buildings in which the service is of an intermittent character with large maximum and small minimum load.

In collecting the data many items of interest were incidentally brought out. Thus coal of small size gave better results weight for weight than larger sizes so long as they were provided with suitable furnaces.

Also gas engines show an economy where the heating of the building is a small factor. Storage batteries are useful where the service fluctuates and where steam of low pressure is needed during the day for heating or drying.

Taking hotels first as having heavy and continuous service, a large plant is needed, and there is always much power and steam required in a hotel. Public supply cannot possibly compete with an isolated plant in a hotel, and yet many hotels buy current from without. In two hotels of similar nature thus compared, one has its own plant and makes its own ice and cools its store rooms, and pays $10,500 per year for fuel, labour, and repairs. The other hotel which buys current pays $13,000 a year for ordinary services and a further $11,000 for light as well as having to buy ice.

Two other hotels, on similar lines, tell the same tale, while yet a third pair shows $16,000 a year in favour of the isolated plant, despite the fact that it is old-fashioned. The hotel now dependent on the outside main would save the cost of its own plant in eight months. Another hotel of double the size of this latter, but having its own plant, is stated to cost $14,000 less per annum on this account, and all the hotel comparisons show similar results. Again, in two large apartment houses the saving effected by the one with its own plant is enough to pay for the plant within a year.

In two smaller houses of the same class, the private plant would pay for itself in a little over a year. Other comparisons show the same results. Considering the large numbers of apartment houses now going up in London, it is rather a matter of surprise that they do not adopt the isolated plant, which in conjunction with the private artesian well would make such buildings self-contained for light, warmth, refrigeration, and water. Too frequently, however, is it a fact that these matters are left to an architect, who, of all men, seems to hate machinery, and possesses the smallest insight of things beyond his narrowest sphere. Even when an architect does deign to have any machinery put down, he relegates it to the darkest and dirtiest corner he can find for it.

A METHOD OF WORKING TELEPHONE EXCHANGES FROM THE ELECTRIC LIGHT SUPPLY.

By C. A. SMITH.

In many large telephone exchanges, especially those where self-replacement indicators are used, secondary cells have to a great extent taken the place of primary batteries. The secondary cells of necessity require charging, and the methods employed for doing so may be summarised :—

1. A special dynamo and engine may be put in.
2. Or if the district has an electric supply, a motor-generator plant may be used; or,
3. If the supply is of low pressure, the batteries may be charged direct therefrom.

While in some places cells are charged away from the exchange and delivered as required. In either of these methods a duplicate set of cells must be used—one set charging while the others are being used, and in the first three cases an elaborate switchboard is necessary for charging the cells and connecting them to the various transmitter circuits.

The following method is suggested as being efficient and more economical than any battery system can be. It can be used in any place where the supply is a direct current.

The apparatus is shown in diagram (fig. 1) and consists of a number of resistances, R_1 R_2 R_3, inductively wound, placed in series with a suitable choking coil, to eliminate as far as

possible the intermittent effects of commutation. This apparatus can be put in series with a glow lamp or other suitable resistance and connected directly across the supply mains.

Each transmitter circuit put as a shunt across one of the resistance coils, R, and need only to be slightly modified, the induction coil being wound so as to have a little more in-

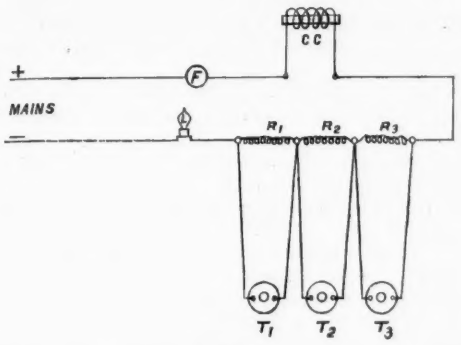
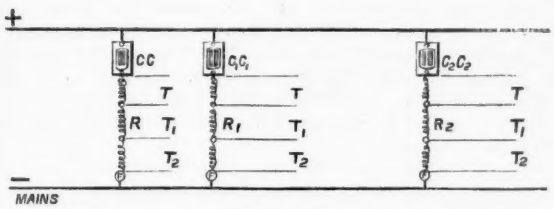


Fig. 1.

F, Main fuse; L, 16 C.P. lamp; T_1, T_2, T_3, Transmitters; R_1, R_2, R_3, Resistance coils; C, C, Choking coil.

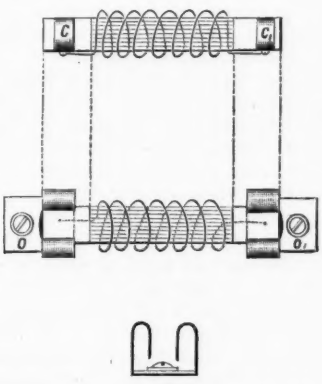
ductance than is usually the case. The method has been experimented with on a 110-volt supply system, using resistances of 5$^{\omega}$ each, in series with a 16 C.P. lamp and a low resistance choking coil. The noise produced in the telephone,



C, C, Choking coils (same resistance as glow lamp); R, Inductive resistance coils; F, Fuses; T, Transmitter circuits.

Fig. 1A.

due to the dynamo commutations, were practically *nil*, and the speaking was very good over a line of considerable length.



C, C_1, Contact pieces; I, C, Iron core (tubing); O, O_1, O_2, Spring clips.

Fig. 2.

To make such a suggestion a commercial success, a number of coils—say 42—could be fed from the one pair of supply mains and connected in multiple, so that 14 sets of three coils put in series with a choking coil and bridged across the mains through a fuse. The total resistance of each set being equivalent to that of a lamp, and would therefore take about ·5 ampere, the current required to work a transmitter. In fig. 1A is shown three sets of three potential coils.

It would be advisable to have the coils (iron core-tubing) made and mounted similarly to a bridge fuse (fig. 2), so that in case of accidental breakage a fresh one might quickly be substituted. Of course, the insulation would have to be looked after and leakages to earth avoided, but these are points which apply equally to a battery system. In cases where the pressure of supply is high, or where alternate current systems are being used it would be necessary to make use of a motor-generator to give the necessary continuous current.

Sufficient current could be obtained in the same way for working the self-restoring indicators.

I am indebted to Mr. Coultas, of the Birmingham Technical School, for his valuable assistance in making the suggestion an experimental success.

ELECTRIC METERING FROM THE STATION STANDPOINT.*

By CARYL D. HASKINS.

In many central stations to-day, I find that, while managers are almost universally in favour of an exclusively meter basis, a large proportion are still in ignorance as to what qualities they should seek and what they should avoid in selecting a meter.

In response to an inquiry as to what merits in a meter are necessary to success, a common reply is, accuracy, durability, registration in a simple unit easily comprehended by the customer, and ability to withstand tampering.

Let us, for example, consider the broad question of accuracy. A meter which will be accurate under commercial conditions from quarter load to full load within 1-10 of 1 per cent. of a meter which will *start* on 1 per cent. of its rated capacity, are neither of them necessarily either the most accurate or the best for general commercial use. This latter point is one which is frequently raised. The fact that a meter will start on 1 per cent. of its rated capacity is in reality no sure criterion of the accuracy of that meter, even on light loads. It is not necessarily even good evidence; yet I find that in very many cases this is almost the only test applied to meters at the time of purchase. The percentage of accuracy at light loads is very important, more important, I believe, than is commonly appreciated; but I am perfectly safe in saying that a meter which will run within 5 per cent. of zero error on 5 per cent. of its rated capacity may readily be a much better meter, even though it will not run at all on 1 per cent. of its rated capacity, than one which will run on 1 per cent. of its rated capacity, but in regard to which no evidence is at hand as to its percentage of accuracy at reasonably low loads.

Ability to start on very light loads is certainly an *indication* of merit, and is important; but it is not nearly as important a point to determine as is the lowest load at which a meter begins to register with fair accuracy.

In considering the question of accuracy, therefore, the first two steps should be to determine the accuracy of the meter by actual measurements at full and medium load; and also at a reasonably low load; say, for example, 5 per cent. of the meter's rating.

That low load accuracy is really of vital importance is well shown by the fact that, with the average 24-hour station, in the neighbourhood of 15 per cent. of the total station output goes to feed one and two lamp loads. Yet, in the face of this, I have seen large installations of meters reported as entirely satisfactory, tested with frequency and care under admirable systems, but only at full or medium loads, and yet failing to account for more than 50 per cent. of the one two lamp loads, or, in other words, losing to the

* Extracts from a paper presented at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 27th, 1897.

illuminating company an average of probably 7½ per cent. of the revenue which their measured station output should give them, after deducting for legitimate losses.

Granting that, having determined the actual percentage of accuracy obtainable at light, medium and full loads, a very important, and, in fact, probably the most important evidence as to accuracy has been obtained, there still remains much information of vital importance which should be sought, and which should materially influence a decision.

One point which is very commonly neglected, but which is, nevertheless, quite essential, is the ability of a meter to give accurate results for brief periods on overloads. This is a point on which many meters fail, and it is also a point which, odd as it may seem, is intimately related to light-load accuracy. It may be laid down as a rule that in station operation the smallest meter which will do the work should always be used. Otherwise, however good the meter on light loads, much of the light-load revenue must be lost in the effort to take care of occasional heavy loads. Extremely heavy loads are generally of brief duration, and on these loads a meter should operate with accuracy, and also without injury to itself. This, therefore, should be an early point of investigation in selecting a meter.

On alternating circuits inductive loads are becoming commoner every day. The wider use of fan motors and other alternating-power devices, the rapidly growing popularity of alternating circuit arc lamps, and the commoner use of inductive dimmers, all render it essential that a meter should be accurate irrespective of the power factor.

Even after this long list of points which must be investigated, as contributing to the broad question of accuracy, there are others which also merit consideration, but to a less degree. Such, for example, as barometic conditions (more especially altitude), temperature, and humidity. These all have direct bearing upon the question, and all enter into the every-day conditions of central station practice.

Summing up the question of accuracy, we may say, therefore, that the following points should be investigated with care:—

Ordinary volt-ampere accuracy.
Accuracy on inductive loads.
Accuracy on varying wave forms.
Accuracy on overload.
Accuracy on varying frequencies.
Influence on accuracy of variations of temperature, barometric conditions and humidity.

The second point, which is commonly given consideration in the selection of a meter, is that of life. This is a question which must depend more upon good judgment than upon any test which can be applied; for it is in reality no test of the enduring qualities of a meter to run it at excessively high speed for a relatively brief time. The life of a meter, in other words, cannot be measured by revolutions, irrespective of the speed of those revolutions; nor can it be determined by the speed at which it rotates alone.

Ninety per cent. of all the wear in a meter centres in the case of motor meters at the single-jewel bearing, which is almost universal. The two chief factors which have influence upon the mere mechanical life are the weight of the moving mechanism and its speed, the variation of the area of the paint of contact being, of course, always so small as to be out of consideration.

More than half of the meter jewels which are destroyed are rendered useless, not by the rotary motion of the shaft, but by reciprocating motion of the shaft, due to vibration. Hence it is very necessary that the jewels should be in some way cushioned, for vibration cannot be always avoided.

These are all, I admit, mechanical considerations, but they compass much of failure or success in electric metering. The purely electrical features of the meter contribute no grave factor of consideration in connection with the life question, always supposing that the copper is ample and the potential windings are so distributed and so ventilated as to preclude a burn-out.

Passing over the central station man's third factor for consideration, that of the best unit of measurement, as one which is practically a closed question, we are brought face to face with his lamentable fourth point, the necessity that the meter should be able to withstand tampering. It is a regrettable fact that this is a consideration which is coming daily into more prominence; but light has to be sold to all sorts and conditions of people; and apparently the transgressor against meters is even more common than the transgressor against taxes; and this is a growing evil, largely, perhaps, because of the lax conditions of the laws, which can be invoked to protect the meter owner in many of our States.

Meters should be installed as near to the foundation as possible, not, as is now quite common, at the top of buildings, where the amplitude of all vibrations is, of course, much greater.

Locations where great variations of temperature occur are undesirable. For this reason, also, basements are preferable to attics.

A very common error, causing the loss of very many meters annually, by the burning out of the potential circuits, occurs in connection with the metering of power delivered to motors. In the effort to save the very trivial amount of energy passing through a potential circuit, it is very common to install meters on the motor side of the controlling switch. This not only exposes the meter to the full force of the field discharge, but it also results in the constant cooling and heating of the potential winding, and the resultant expansion and contraction chafes and weakens the insulation, and also weakens the wire itself at the turns, opening the path for a final breakdown either by a lightning discharge or by a field discharge.

As to care of meters, it is a fallacy to suppose, as many insist upon doing to-day, that meters should require no care whatever. Almost all meters will continue operative for a long period without any care whatever; but the cost of a cleaning and testing visit twice annually is trivial as compared with the good results which follow such a system, by reason of the better light-load accuracy obtained. It is not, I think, too strong a statement to say that such a system will have an influence for good, amounting to from 3 to 5 per cent. on the meter readings annually.

Central station managements have probably given more attention to systematic methods of meter reading than to any other one point contributing to success. The old and faulty plan of reading the dials of a meter at the time of the visit to the meter is fast giving place to the better system, which provides the reader with a facsimile of the meter dial in blank upon a page of his meter book. This facsimile is roughly marked in pencil to indicate the position of the hand at the time of the visit. These facsimiles are taken into the office and are all read by one individual who is an expert in meter reading, and who sets down the consumption under the facsimile on each page. Such a system commonly reduces the errors from about 10 per cent. per month, where they not uncommonly stood under the old system, to materially less than 1 per cent. under the new; for, surprising as it may seem, it is an extremely easy thing to make mistakes in reading meter dials.

In changing from the old and not infrequently popular contract system, a good many central stations in the earlier days made the grave blunder of going on to the new basis during the winter months, with the result that the highest bills of the year reached the customer after a long period of indulgence under the contract system, and the result at times proved temporarily disastrous.

I do not feel that I shall be doing justice to my subject should I fail to make at least brief mention of the application of meters to the measurement of station output. In all commercial enterprises it is difficult to satisfactorily guide and control a business, unless there be some positive means of determining how much of anything is produced; and it is surely just as important to all electric lighting companies to know how much of their commodity they manufacture as for any other concern. Until quite recently it has not been possible to obtain recording meters sufficiently large to care for the heavy outputs which are now so common, but such meters are now readily obtainable.

The value of a system of station meters must necessarily prove very great, since it furnishes an absolute check system upon coal and water consumption, and engine and dynamo efficiency, while it also furnishes a ready means for comparison between station output, customers' meter indications, line losses, leaks and grounds.

A HORSELESS BROUGHAM.*

In the *Scientific American* for March 13th, 1897, we illustrated the hansom cab† of the Electric Carriage and Wagon Company, of Philadelphia and New York; we now show the Morris & Salom brougham. It is just about to be put in operation in New York City. The hansom cabs in New York are giving great satisfaction and are in constant use, and it is expected that the brougham will be as popular as the hansom.

It embodies many features considered of great importance, the principal one being what is known as the "Tracteur" principle, and consists in mounting the motors, gears and batteries on the front truck or axle, thus maintaining back of the battery line all of the features of standard carriage construction, the body part of the brougham being built on precisely the same line as those intended to be drawn by horses. It is evident that this principle adapts itself to the construction of all sorts of carriages, such as landaus, victorias, cabriolets, opera coaches, &c. The new brougham is provided with 2 horse power Lundell motors and a battery of 44 3 F. elements of the Electric Storage Battery Company. The motors are wound for 900 revolutions per minute and gear directly with a single reduction to the internal gears on the 36 inch driving wheels. As the motors are independent, the differential action in turning is obtained without the necessity of countershaft with balance gears. Motors are mounted on the axle and swing radially about the same; and are supported on the opposite side by spiral springs attached to the body.

The accumulators have a capacity of 100 ampere hours each, making the total battery capacity about 12 horse power hours, which is amply sufficient, owing to a very high efficiency of the motors and the means of the transmission of power, to drive the vehicles fully 25 miles under ordinary street conditions. On asphalt pavements and small gradients 36 miles have been run without recharging. The average speed is six miles per hour. The wheels are of the wire suspension type, fitted with brass hubs and ball bearings, and pneumatic tyres of three inch section. The steering is accomplished by moving the rear wheels in parallel planes by means of a lever placed on the right hand of the driver. The controller is placed under the driver's seat and is operated by a small lever with the left hand, it being arranged so as to permit of three speeds ahead and one back. The carriage is elegantly finished and has luxurious fittings, and weighs very little more than the horseless hansom cab.

THE ENGINEER'S STRIKE.

In connection with the question of the relative output of an 8 and a 9 hours' day, *Engineering* says that as regards mere manual work the difference of output would probably be small, but if our factories are properly equipped with machinery running at full output a shorter day must inevitably reduce production. But are machines run at full output? Probably not; or why should firms who have tried 8 hours find no difference? Simply because previously the men had taken things so very easily and 8 hours had been shown to be a success in one or two cases because the Unions had ordered it to be so. But, argues *Engineering*, when the 8 hours is general, there will be no reason to order any one set of men to push it to a success and the whole of the men will fall back upon their original 9 hours speed. That this is probable the present temper of the workmen shows to be only too likely. Even in shops that have conceded the 8 hours, no effort is made to help forward the work, but it is carried on in so half-hearted and perfunctory manner as to leave no doubt that in the minds of the A.S.E. the intention of 8 hours is not for the convenience of the man coming from a distance, but simply to provide work for more men or to provide for more dearly paid overtime. That it is desired to abolish overtime is a perversion of the truth, and deserves branding as such in plain and unmistakable language. Ask any proprietor who has abolished overtime and conceded the 8 hours, and he will tell you he cannot get his work done in the 8 hours day, but every effort is made to force overtime upon the shop by getting work behindhand. In connection with the question of output of machinery our contemporary quotes Mr. Miller, of the *American Machinist*, who has been on an European tour, and states that he has found instances where American tools here are doing but half and two-thirds their American output. Making every allowance for that playing to the gallery which so many Americans practice, when writing to please the "boys" at home, there is much to be said on this score. Then again, trained English workmen who go to America and get free of the thraldom of the Union are well known to be able to do more work than the Americans.

Our trades unions discourage also the use of special tools with a cheaper grade of labour which alone renders possible the rapid and economical production of standard "lines" of goods. The manufacture, as distinguished from the building of machinery demands large numbers of special machines, each equipped with its own particular tool and stop pieces to operate upon given pieces of metal and provided with particular chucks to hold just such pieces and no other. One turns part of a piece; a second bores it out; a third mills a groove; a fourth drills a hole transversely, and further machines perform other little operations upon a bit of, possibly, steel very closely drop forged to size. When finished the pieces are ganged and passed or rejected as may be, either permanently or for the re-doing of one or more of the operations if by some error too little stock has been removed. A skilled man arranges each machine to hold its work and fixes the stops and tools. The attendant simply turns a handle. In watch machinery the attendant cannot even turn the handle to excess which might spring the stop pieces, nor can he make the chuck grip too power-

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*Scientific American. †See Electrical Review for March 26th, 1897.

fully upon its work. A mere boy or girl can do such work, and can do it more quickly after a few hours practice than the most skilled engineers. Obviously such work can only be payingly undertaken in this way. But the A.S.E. will have none of it, and the inevitable result must be that such repetition work will go to America or Germany. We very much question if the leaders of the A.S.E. are themselves tradesmen, or have the slightest knowledge of the conditions of the engineering trade. Had they such knowledge it would be impossible that they could honestly pursue their present policy. Touching this, it would be highly interesting to see Mr. John Burns, Mr. Tom Mann, and others we could name, become employers of skilled labour. They would easily secure the best men in the country, and it would be an object lesson to watch their methods of procedure in competing for the business of the country. Why do they not embark in such an enterprise and practice what they preach? We have already said that the A.S.E. do not insist upon their members giving a fair day's work. We repeat this and have good reasons for doing so. It is a pity these things should be because when we find skilled workmen spending hours where minutes would suffice, it shows that there is something not quite right. English trade was certainly not built up on half-hearted and lazy work. It will not last on such a basis, and it is idle to suppose foreign competition can be met on existing lines. Eight hours or ten hours we care little about. We lay no stress on the arguments of *Engineering* as to the reduction of output even by machinery. It is an easy matter even with automatic machinery on often repeated operations to be slow or quick as desired. The whole question is in a nutshell—it turns entirely upon the spirit which actuates the workman, and that spirit is at the present time very seriously at fault. We are by no means of those who are invariably on the side of the employer who in the past has often made a fortune out of sweated workers. This cannot be laid at the door of any firm of engineers to-day employing union workers, for there is a minimum of wage. But the union workman is like Charles Lamb, who apologised for his late arrival in the morning by pointing to his early departure from work in the afternoon. So with the amalgamated engineer. With his minimum of wages limit he combines a minimum of work. Obviously such a combination cannot last permanently. The amount of work to be done will become a very small minimum indeed if the tactics of the A.S.E. last much longer. It were sincerely to be hoped that the workers in receipt of wages so good as they now are, would endeavour rather to relieve their ranks by pension of the infirm and old, and by accumulating a huge fund of benevolence. Did they act in a spirit of this kind, they would be everlastingly safe against the possibility of tyranny from their employers, and perceive as, indeed, many do perceive, that the trades union as a mere fighting agency is entirely unnecessary, that, in fact, as was said of another body which wrought better than it knew in King John's days, it is useless, dangerous, and ought to be abolished. So with the Trades Unions, they have done good work in their day, but have failed to perceive that their day for fighting is over, and that they ought to fortify the position they have won. In place of doing this they have elected to spend their funds in war, and by so doing have done much to bring upon themselves two disasters when the first period of bad trade comes upon us. They have impoverished many firms who will be unable to weather the storm, and they have embittered the stronger firms who will shorten hands and reduce wages at the first opportunity which bad trade may offer them. Without funds such opportunities to reduce wages cannot be so well resisted by the men. A large fund, on the other hand, would be a guarantee against unreasonable reductions being attempted. The A.S.E. has abandoned its strongest position, and surely the men who support such wrong-headed leaders must be very weak-minded. The Board of Trade report of the working of the Conciliation of Trades Disputes Act is curious reading, and its issue at this very moment very opportune. It appears very clear that the general purpose of all trades unions has been to limit output from machinery and convert all its members into so many stocks and stones. No man must do anything except along the narrowest lines, and like the 18th century queen, who shivered in her nakedness as her garments passed from hand to hand through the lines of etiquette and procedure, so trade in England is languishing while fools dispute as what pertaineth into bricks and what may be touched by a fitter. The British workman is fast losing his senses, but there is a little satisfaction in noting that this is becoming apparent to some of the better informed labour leaders, judging from their letters to the press.

UTILISATION OF EXHAUST STEAM.

The laws of the thermo-dynamics tell us that if we add heat to water and convert it thereby into steam we can convert some of that heat into the more material form of energy which we call work. The same laws put a limit upon the amount of heat which is so convertible. When, therefore, we heat water we know that the larger proportion of this heat is irretrievably gone so far as its power of performing work is concerned. This lost heat is, or should be, a valuable bye product which ought, if possible, to be saved. Attention is drawn to the question by Mr. Thayer in the *Electrical World*, who points out that four-fifths of electric light stations are wasting a bye product of greater value than is the case in any other industrial concern for the exhaust steam carries off 85 per cent. of the heat supplied to the boiler. Can this stream of energy be diverted to a useful purpose? Though he does not give any information as to the means employed to secure circulation of steam through far distant radiators he states that there are methods of circulating steam without any back pressure on the engines. Care is needed in designing and laying steam mains. Three conditions must be provided for, namely, small radiation losses which should not be so much as 5 per cent. unless excessive distances are included. There must be provision for expansion and contraction. With a range of from 50° to 212° a main 100 feet in length will vary 1⅜th inch. There must be protection from surface water which is very corrosive of the mains. As regards rates of charging these vary much. There is a tendency to charge for the capacity of the space warmed instead of for the area of radiation surface. For a store 20ft. × 80 × 14 the charge is £12. The necessary radiating surface is about 250 square feet so that the charge is about 1s. per square foot. Such a store will use 5 to 7 tons of hard coal annually. At 30s. per ton the annual cost will be £9 or £10. Hard coal costing 30s. it follows that waste heat has a costly fuel to compete against.

A square foot of radiating surface will condense one third of a pound of steam per hour. The heating period is set down at 5½ months. (It would be practically that also in England.) The fuel cost of this will be 9½d. with coal at 8s., and only 7 lb. of evaporative power. With a revenue of only 1s. per foot the business would not yield a profit. Mr. Thayer may here be quoted, remembering that 2 cents. equal a penny: "In the stations of towns of less than 15,000 inhabitants, 75 per cent. of the maximum evening load will be carried for five hours during the heating season. Outside of these hours the load will run about 30 per cent. for the remainder of the lighting hours. The day power load, if any, will hardly exceed the all night load. The conditions will be that the first floor 30 per cent. of heating business can be done with exhaust steam for at least 14 hours per day. The fuel cost of live steam furnished will be 11 cents per square foot. Another 45 per cent. can be supplied with exhaust steam five hours per day at a fuel cost of 15 cents per season. This would indicate that the profitable heating is that which can be taken care of during the greater part of the evening load. Cost of fuel will determine in each case whether new business will pay on a live steam basis."

With this in view the use of storage batteries assumes a fresh importance, for they can take a part of the load during the time when heat is wanted and the engines running to supply the heat may grind out electricity, which can be stored and given out at a time when light is wanted. Heating and storage batteries between them enable smaller engines to run on a longer and steadier load.

Again, to quote the author.

"Once a heating system can be worked up, it becomes easier to secure paying power or day loads. When heat is wanted the machinery can be run for a little extra expense, and in warm weather a fan motor business should be profitably possible. The suggestions appear calculated to afford a future for central station practice of a character more steady than

hitherto possible. Interest and depreciation must always be a heavy tax on a station given over to light with power as a side issue." There can be no doubt that an enormous amount of heat is deliberately wasted in every kind of industrial operation. We have often seen high pressure engines driving well pumps and discharging their exhaust heat to the air, while at the same time, the pumped water, or much of it, was immediately heated by either fire or live steam. A small surface condenser would have easily absorbed all the waste heat of the pump. In the warming of factories it is very doubtful if the high pressure system of steam heating is so economical as would be a more bulky system of pipes forming a portion of the exhaust circuit and saving condensing water. If the heat must be used any slight addition of back pressure on an engine, if the engine be big enough—would be no loss, and might even be a gain. It certainly would be an economy to the extent of the heating obtained. North country engineers are apt to pride themselves on knowing something of steam economy. They know nothing, if we only consider that the town of Oldham, for example, is thickly studded with factories of about 1,000 horse-power each, and every factory is closely surrounded by hundreds and hundreds of houses. Yet these Oldham people do their best to work their big engines on the condensing plan and use ponds of water which at times get hot enough to kill a man who may fall in. Why cannot all these houses round about receive their water heated for them by the factory? As it is, any hot water required is heated in the kettle, and as the smallness of many of the houses has a tendency to mix up the domestic arrangements, the baby sometimes drinks out of the kettle spout, and more money is spent on the funeral than would have piped that cottage for hot water. We might multiply instances, but everyone, no doubt, can recall for himself possibly numerous cases of waste of the kind we note. The waste heat from an engine of 1,000 horse-power may easily represent the total heat of 40 tons of coal per week, or, say, 2,000 tons a year. If a half could be utilised there would be heat enough to warm hundreds of houses. The possibilities of practical savings of waste heat are simply enormous.

CORRESPONDENCE.

Postal Telegraph Clerks.

I, also, was extremely surprised at the attitude of the Electrical Review towards the grievances of telegraph clerks. The confusion is to a great extent due to the official hair-splitting. Telegraphists never have objected to technical examinations provided that the extra value acquired will be remunerated. The recent concession to the Junior Staff is a step in the right direction, but yet it is not without a large amount of unfairness. The position is this. Previously all clerks of good character and manipulative ability could proceed to £190 per year. The telegraph service being of recent growth, the department did not consider the maximum salary, as few men were in receipt of it, but as the years advance a greater proportion of older men will be in the service, and, consequently, the salaries will increase in amount. The Tweedmouth Committee not only confirmed the recent innovation (a technical examination) at the £160 point, but also stated that all clerks above that point should rank as "overseers." The latter is the chief grievance. A man may be a Preece in embryo, but he cannot rise beyond £160 unless a supervising vacancy exists. Few superior appointments are needed in the telegraph service as each clerk is held responsible for his particular work, and so the chances of the average clerk with, or without technical knowledge, rising beyond £160 per annum, is about equal to a drummer-boy becoming a colonel.

It should be remembered that a clerk is in the Government service 12 years before receiving £2 2s. per week, and has been on the establishment 20 years before receiving £160 per annum. No wonder discontent prevails. Prof. Jamieson well understood our case, and offered to give evidence before the Tweedmouth Committee, but that body declined to hear him. Instead, Mr. Lewin Hill, who admitted he knew nothing of the work, was credited when he stated a man of average ability could learn telegraphy in three months. He has since been challenged in the presence of the Duke of Norfolk to quote a case but has failed at present. We are not afraid of technical examinations, but up till the present the department has but slightly encouraged students in these matters, sometimes even punishing clerks for endeavouring to adjust the instruments. When technical examinations are introduced, not to promote efficiency or encourage deserving officers, but as artificies to promote economy, we shall fight against the introduction. The department has one aim in view: the amalgamation of the sorting department and the telegraph service. Economy is the cry, though Mr. Fischer warned them it would be at the expense of efficiency. The telegraph service can never expect just treatment until it is treated on its own merits by competent men instead of Post Office bureaucrats.

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Electrical Cables.

I, with a few electrical friends, had the pleasure to-day of being invited to the inauguration meeting of the Electric Cab Company, and as electrical men we were all very pleased with the successful issue, and very heartily congratulate the company on their success.

Mr. Preece's speech was very good as his generally are, but we looked for a statement that did not forthcome and we felt disappointed by the omission. Mr. Preece is a man of forethought and foresight, he has told us that by extension of the telegraph system and by signalling without wires, we may some day telegraph to our neighbours in Mars; he told us that the electric light would be the "poor man's friend," and to-day we looked forward to hear that the electro-motor car would in the future be "the costermonger's vehicle," and that the horrible and unmechanical invention of the horse would put horse and ass power in the minority.

C. E. Spagnoletti.

August 19th, 1897.

The Meters of To-Day.

I notice in your last issue an abstract of a paper read by R. F. Schuchardt on "The Meters of To-Day," in which one of the chief objections attached to "the two clock meter" is that if the meter be neglected and not wound up at the proper time, it will run backward and destroy all former readings.

Surely this objection could easily be provided against by adding a simple automatic arrangement which, when the faster clock was all but run down, would cause both clocks to be stopped simultaneously.

W. D. Kilroy.

EFFICIENCY OF COMBUSTION IN A BOILER FURNACE.

Circular No. 9 of the Steam Users Association of Boston, U.S., contains the report of Mr. Hale on efficiency of combustion. Mr. Hale premises that he has already defined efficiency of heating surface as the ratio of the total heat put into the steam, and the sensible heat in the furnace. The efficiency of combustion is defined as ratio of the furnace heat and the heat potential (termed latent heat) of the fuel. If coal be burned completely, all the latent heat becomes sensible. The combined efficiencies above defined are the measure of the boiler efficiency as a whole. Any falling off below the maximum possible is thus due to more or less incomplete combustion, and Mr. Hale, in dealing with his subject, takes first the amount which the efficiency falls short of perfection by reason of unburned fuel in the ash pit and flues.

This loss is caused by, or dependent upon, the width of grate opening, and increases as this dimension increases. It also varies with the size of the coal, increasing as this becomes smaller; increasing also probably with non-caking fuel, with the increase of the ash percentage in the fuel, though in a less ratio, being less with fan than with steam blast, and being greater with disturbance of the fire bed as with mechanical stokers with moving grates. The following tables will be useful as illustrating the percentages of loss due to the above causes:—

Frankfort Electrical Exhibition, 1891.

Test.	Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.	Test.	Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
1	8·03	41·4	3·3	5	4·3	38	1·6
2	5·9	36·6	2·3	6	6·9	43	3
3	6·6	28·7	1·9	7	6·3	33	2·1
4	1·6	36	0·6				

E. B. Coxe (*Trans.* N. E. Cotton Mfg. Asso., 1895) found, when using his travelling grate on small-sized anthracite coal:—

Per cent. refuse.	Per cent. carbon in refuse.	Per cent. to total coal.
10·05	18·68	2·2
23·7	11·92	2·7

W. H. Bryan found as follows, using soft coal:—

	Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
Common grate	13·35	31	4·3
Down-draught grate ...	14·31	25	3·6

Tests on Pennsylvania coal (Clearfield region) gave, with grate bars 1⅛ inches wide and 1 inch apart:—

Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
16·1	25	4

Other tests gave:—

Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
10·3	37·2	3·8
9·2	31·3	2·9
18·5	29·3	5·4

The same coal with a mechanical stoker:—

Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
13·61	67·8	9·2
18·7	67·2	12·5

The very high losses with stokers are due to the continuous motion of the grate bars. It is not difficult in most stokers to catch and refire the good coal that falls through.

Arkansas State Geological Survey Report, 1888, Vol. iii., p. 73:—

	Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
Pittsburgh coal	8·10	26	2·1
Arkansas coal	10·3	30	3·1
" "	40	83	33·20
" "	14	51·4	7·2

Dampfkessel Revision Verein Berlin Geschafts Bericht, 1895, p. 79:—

	Per cent. refuse.	Per cent. combustible in refuse.	Per cent. to total coal.
Coal-dust firing	4·8	50	2·4

In determining the actual combustible in the ash, it is not sufficient to take the difference between the amount of refuse shown by the test and that shown by the analysis of the coal, for much of the earthy matter is carried into the flues, and does not therefore count in a mere ashpit sampling. So light is some ash, that the total ashpit refuse may be less than the total ash in the coal.

A case in point occurs to us as we write, in the Kaitangata coal of Otago, New Zealand, a coal very considerably removed from lignite, yet burning to a white ash, exactly like a wood ash, and so very light, that the stokers on the steamboat preferred the coal, because with it there were no ashes to wind, for everything either was combustible, or was drawn up the funnels by the draught. The loss of combustible cinders up the chimney has been tested by Mr. F. Goss at rates of combustion below 40 or 50 lbs. per square foot per hour to be unimportant, and the solid matter in smoke seldom shows over 2 per cent., including earthy matter and condensed hydro-carbons.

It is not stated whether this observation applies also to sprinkling stokers or dust fuel firing, but we should imagine not, both these systems being characterised by extremely dusty chimneys.

The second loss to be dealt with is that due to incomplete combustion in the sense of partial chemical combustion, the fuel being reduced to monoxide of carbon and to various hydro-carbons, instead of to the two completely oxygen satisfied oxides, viz., CO_2 and H_2O. Soot is considered as a hydro-carbon. In this connection Mr. Hale specifies various critical temperatures. We quote these as given. They are as follows:—

(*a*) Previous to putting on a charge of coal, the temperature of the bed of coals is from dull red heat (700° C, or 1,292° F.) up to a bright white heat (1,400° C. or 2,552° F.), or even higher.

(*b*) The coal, when fired, is about 15° C. or 60° F. (temperature of the room). As soon as it reaches the firebed it begins to heat by conduction from the hot coals beneath. The hot gases—products of combustion of the coal beneath—also heat the new charge of coal.

(*c*) The heating of the coal causes the volatile matter to distil off. The amount distilled at any given temperature is unknown, but it is certain that traces of volatile combustible matters are given off as low as 110° C. (220° F.).

(*d*) At about 400° C. or 750° F. the coal reaches the temperature of ignition, and burns to carbon dioxide.

(*e*) At about 600° C. or 1,100° F. most of the gases given off by coal (hydrogen, marsh gas, and other volatile hydro-carbons) will ignite if oxygen be present.

(*f*) At 800° C. (1,470° F.) the carbon dioxide, as soon as formed from the coal, will give up one atom of its oxygen to burn more coal, thus $CO^2 + C = 2\,CO$. This carbonic oxide will burn back to carbon dioxide if mixed with oxygen at the necessary temperature, which is between 650 and 730° C. (1,200 and 1,350° F.).

(*g*) At about 1,000° C. or 1,832° F. the H_2O formed by the burning of the hydrogen in the volatile matter in the coal begins to dissociate.

(*h*) At about 1,000° C. or 1,832° F. any carbon dioxide not previously burned to carbonic oxide begins to dissociate to carbonic oxide and oxygen.

(*i*) The various hydro-carbons which begin to be distilled at 110° C., and possibly lower, undergo many changes, dissociations, and breakings-up at the various temperatures they pass through. So many of these are unknown that it is useless to state the few we do know.

Above 700° C. (1,300° F.) both the hydro-carbons and the carbonic oxide will unite with oxygen if the latter be present, and intimately mixed with them. If they do not burn, the tendency is always to break up into simpler and more volatile compounds as the temperature rises.

The foregoing shows merely possibilities. The actual perfection of combustion depends entirely upon the oxygen supplied by the air, that in the coal being practically of no account, if indeed it be not already in full or partial combination.

Obviously the small content of oxygen in air must be a huge factor in results, or rather, we should say, the large content of inert and useless nitrogen. The effect of nitrogen is to dilute the oxygen and keep it apart from the fuel. It acts also as a reducer of temperature, the furnace temperature being let down very nearly in the ratio of the total air to its contents of oxygen. Further, the very presence of nitrogen, by hindering the combustion, compels the use of more air than is chemically necessary, and still further reduces the furnace temperature. It is to these things that imperfect combustion is due, for the furnace temperature at times may be driven down so very low, that a fresh charge of fuel will simply distil, but not burn. The amount of air exercises, therefore, very great influence upon economy and efficiency, the consideration of which forms the continuation of Mr. Hale's report.

UTILISATION OF HEAT REJECTED BY GAS ENGINES.

There is nothing so attractive to the frugal mind as the economy to be secured from utilisation of heat thrown away by heat engines. So small a proportion of heat is converted into power, that practically all the heat is thrown away, and in America, where with so great a demand for steam heating, and people live in a hothouse atmosphere, the question of economical steam engines as against cheaper engines of less economical type, has often been solved in favour of the cheap engine, because there is a full demand for the otherwise waste heat for heating purposes. Under the title of utilisation of the heat rejected by gas engines, Mr. Stuart is reported in the *American Engineer* as suggesting that something should be done to use the gases escaping from the engine at 30 to 50 lbs. pressure, and apparently fit for further duty. Were expansion to be thus carried further, there would be required larger cylinders and general increased strength, while the mean temperature would be lowered, and a less proportion of heat need go to the water jacket, and premature explosions would be fewer, while lubrication could be better effected. The gas engine is full of difficulties standing in the way of economy. Of the total heat generated in the cylinder, three-fourths is lost in the jacket or at the exhaust. Mr. Stuart would use such heat to generate steam for a steam engine, or for heating purposes, the latter, however, being usually out of place in summer time. To raise steam would be difficult, but it does not seem difficult to allow the escaping gases to enter a closed vessel, and to supply them from this vessel to work a steam engine, for which purposes they would not be too hot, nor with a suitable admixture of water need they be too dry. It is simply a question whether the extra cost of the second cylinder is worth incurring for the sake of the extra expansion. The proposition resolves itself simply into a question of compounding with a large intermediate receiver, and with the second cylinder smaller, perhaps, in size, but with a larger piston displacement just as in the compound steam engine.

The second, or low pressure cylinder, would in fact be double acting, and all strokes would be working strokes, so that in size it might be small. Whether such a means would result in economy cannot well be told without experiment.

The present fault of the gas engine is that for power developed it is a heavy, clumsy and expensive machine, and is likely to remain so until some successful means of abolishing its single-acting, four-stroke cycle is established. This is, of course, the great obstacle in the path of the gas engine, and one of those obstacles that will take much inventive genius to overcome.

To overcome it, it would probably demand that the working piston be no longer used to compress the charge, or only partially to do so. An exhaust valve uncovered by the piston, and a supply of air and gas entering under pressure to sweep out waste gases, seem easy methods of getting double work out of a given engine. Have these means been yet thoroughly exploited, or has the comparative ease with which the Otto cycle can be worked put a check on any improvement, or attempts to improve, scavenging systems as outlined above?

ELECTRICAL CABS.

In our issue of last week we gave a full technical description of the driving of the cabs which the London Electrical Cab Company are now putting on the London streets, and the illustrations which we give herewith will be readily understood by reference to our previous article. We also briefly alluded to the inaugural ceremony, and we give below some personal experiences of our own derived from a special trial of one of these electrically-propelled vehicles.

The shape of the "body" part of the cabs is somewhat similar to "coupés," or rather larger than single-seated broughams, but with rather more glass than is usual. The windows right across the front (which are made to open), and the extra side windows, make the carriage very pleasant to ride in. They are upholstered in leather, and possess many more small luxuries than the public vehicles now in use—such as the electric light inside, and in the outside lamps, rubber tyres, spring cushions, &c.

The New Electrical Cab.

The driver's seat is in front, but owing to the rounded dashboard the carriages do not have that appearance of being so utterly incomplete without the horse, which might have been expected. Many persons contend that the driving seat should have been at the back, the same as in a hansom, so that the "fare" could have an unrestricted view. On consideration, it will be easily understood that this might be somewhat risky, as the driver of a motor carriage must be able to see the ground immediately in front of him, especially for traffic in the London streets.

The electric current, as we stated last week, is supplied from accumulators immediately underneath the vehicle. These accumulators consist of 40 cells, constructed specially by the E.P.S. Co., who are under contract to keep them in perfect working order, and guarantee their efficiency. Each set of accumulators has proved to be capable of propelling the carriage over 50 miles, and taking the cost at the agreed price of 1½d. per unit, means 50 miles for about 2s.

The motor is of 3 horse-power, and is of the Johnson-Lundell type; it is placed in the hind boot, and connected by gearing to a counter-shaft, and thence by driving chains to the hind wheels of the cab. These driving chains, by the way, had to be tightened during the trip we mention below.

The great advantage of this particular motor (used in connection with the Johnson-Lundell controller) is that it enables the electricity to be used in exactly the ratio it is required, *i.e.*, there is no perpetual waste of electricity going on through resistance, or other means, as has usually been the case in previous attempts at electrical driving.

The steering and driving of the cab is simplicity itself, and requires no skilled knowledge whatever. Out of 15 hansom cab drivers who were tried, it was found that 12 within two days were quite capable of guiding the vehicle in any traffic.

On the left hand side of the driver's seat is a lever handle; the carriage commences to move immediately this handle is pushed forward, and the more forward the handle is moved the faster moves the vehicle, from 1 mile to 10 miles an hour. Reversing the handle simply means making the carriage go slower, and when reversed beyond the stationary point the carriage commences to go backward. The driver's right hand is occupied by moving a little wheel, which steers the vehicle in any direction. The brake-power is applied by the driver's right foot; directly this is applied the electric current is cut off, so that there is no energy acting against the brake.

It may be here pointed out, that the stopping of these electrical vehicles is far more under control than any horse-driven carriage, a fact we have demonstrated for ourselves. Not only is it fitted with a much more powerful brake, but the driver can readily reverse the action of the motor, and there is, of course, no horse slipping.

Although they had declined to grant licences to several other kinds of motor carriages, which licenses had previously been applied for, the Scotland Yard authorities unhesitatingly agreed to give the necessary license to these cabs, subject to the sensible restriction that each vehicle should be accompanied by its driver, who was required to prove that he was capable, not only of guiding the carriage, but of turning it in a very small space, and of stopping it immediately when required. These tests were satisfactorily fulfilled.

A special plug or key is in the possession of each driver; without this key it is impossible for anyone to move the carriage. When leaving his seat, the driver simply places the key in his pocket. The advantages of this are obvious.

Now as regards the methods for supplying the electricity, which, from a commercial point of view, are quite as important as the cab itself.

The company decided, principally for the two following reasons, not to manufacture their own electrical energy, but to obtain it from the various supply companies:—

1st.—On account of the cost; the supply corporations were all anxious to supply current during the daytime (when none is required for lighting purposes) at extremely low rates.

2nd. — Because, as the service of cabs increased, charging stations would be wanted in several different parts of London. However, the difficulty was that the voltage at which the ordinary electric current is supplied was much higher than could be transmitted direct to the accumulator. It was therefore necessary to put up motor generators, which transformed the current to the exact strength required.

It is these motor generators which have caused part of the delay, and which can now be seen working most satisfactorily at the factory in Juxon Street, Lambeth.

The well-being of accumulators depends, in a great measure, on being gently handled, severe shocks being most detrimental. The weight of each set is about 14 cwt., so special arrangements had to be made for taking them on and off, and moving them into the required position for being recharged with electricity.

All this has been most carefully and satisfactorily worked out. The electrical cab can be driven on to the company's premises, and driven out again with a fresh accumulator (capable of running another 50 miles) within five minutes. How this is done was fully described in our last issue.

Differing from any other form of motive power for vehicles, it will be seen that electrical ones built on this system have no smell, no noise to complain of, but little vibration, and no possible danger, so far as we can see at present.

They are far more under control than horse-driven vehicles; they can be driven at any reasonable speed, and no accident can arise from horses falling, shying, bolting, or moving when the carriage is entered, a desideratum which we, from a long and somewhat unfortunate experience with horse-driven cabs, appreciate at its full worth.

On Wednesday morning we were driven from Great George Street through St. James's Park and into the thickest of the traffic in and about Regent Street, Piccadilly, Trafalgar Square, Grafton Street, Savile Row, Parliament Street, &c., and later on from the same starting point to Euston Station, whither the genial and ever-courteous Mr. Manville, our guide, philosopher, and friend, had to journey to meet Mr. John Bogart, who had just arrived from the States. Mr. Bogart, it will be remembered, is associated as joint engineer with Messrs. Kincaid, Waller, and Manville to the St. Lawrence Power Company, whose operations we described in our issue of May 21st of the present year. Mr. Bogart was little prepared to find an electrical cab in waiting to convey him to his destination, and in this respect at least he could not have thought the metropolis much behind New York.

Our impressions of last week, favourable as they were to the future success of electrical cabs, have been more than confirmed; but a few slight improvements in the vehicles, especially with regard to the springs, must yet be carried out for giving perfect comfort whilst travelling. The nature of the modifications, however, is well known to the company's officials, and doubtless Mr. Manville, the consulting engineer, and Mr. Bersey, engineer and manager, will quickly remedy these minor defects. Nothing could be more satisfactory than the admirable manner in which these *coupés* can be manipulated in and out of the most congested vehicular traffic, and the ease with which they can be pulled up within the length of a few feet is little short of marvellous.

There is some tendency on the part of ill-bred horses to shy at the electrical cabs, but that is only to be expected on the sudden advent of a four-wheeler rapidly traversing the streets without any visible means of propulsion; they will quickly get accustomed to such unusual appearances, and the ultimate immunity from the daily accidents which now happen in the streets of London which the general employment of electrically-driven vehicles will ensure, is in itself sufficient to make them doubly welcome both to those who have to make frequent use of cabs, and to the nervous pedestrian who every hour runs the risk of being knocked down.

A comparison between these and American electrical cabs may be made by reference to our issue of March 26th.

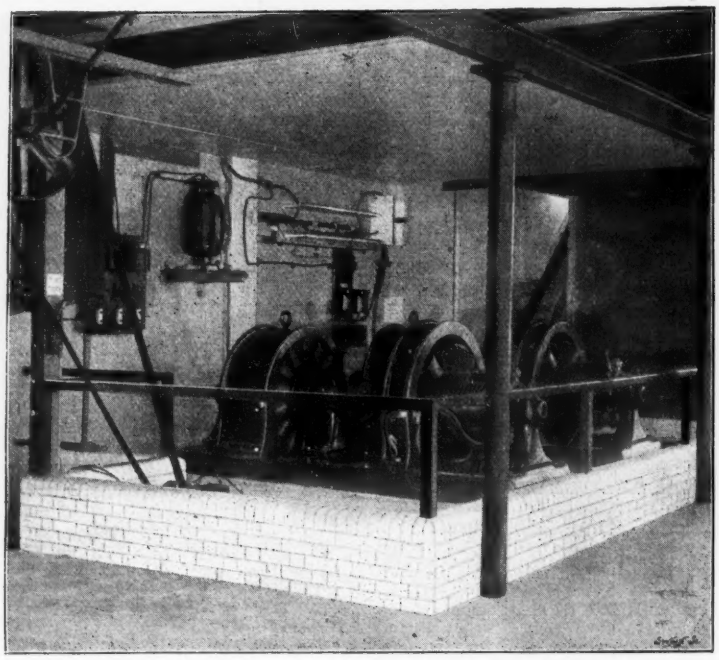
BRAZILIAN GOVERNMENT TELEGRAPH SYSTEM.

(*Continued from page* 296, *Vol.* 40.)

During 1893 very important modifications have been made in the international telegraphic service of Brazil and the republics south of that country advantageously affecting the national treasury and the public. The relations between the government and foreign companies owning cables have also been affected.

The Société Française des Télégraphes Sous-Marins and the South American Cable Company were granted concessions by the Federal Government in 1890 and 1891, and the system to North America, by cables laid from the north of Brazil *viâ* the West Indies and from Pernambuco *viâ* St. Louis, Sénégal, provide new exits for Brazilian traffic.

For several years the Brazilian telegraph administration has done its best to provide new routes for international traffic, so as to compete with the Brazilian Submarine Company, and bring about a reduction of rates, and at the same time enable the national service to participate in outside traffic, which it had hitherto lost by reason of an arrangement existing between the Brazilian Submarine and the Western and Brazilian Telegraph Companies.



Electrical Cab Company's Motor Generators for Charging.

When the Government granted the concession for the laying of the Vizeu cable (now at Pinheiro), they guaranteed to the Société Française des Cables Sous-Marins that all messages handed in at the telegraph offices of the Union for the United States of America and Central America should be handed to them, but the Société Française were not obliged to hand to the Government messages handed to them for places in Brazil.

The decree of June 30th, 1892, authorising the transfer of the concession dated April 11th, 1891, to the South American Company, prohibits an amalgamation of this company with any other telegraph company without the consent of the Brazilian Government, and the concluding of any arrangement with any person or enterprise which may be prejudicial to the Brazilian telegraph service.

Finally an agreement was entered into by the Brazilian Government and the South American Company, which provided that they should hand to each other all telegrams collected by them for transmission beyond their respective lines.

Such was the condition of the international service at the end of 1892.

The South American Company's cable was not opened until October 10th, 1892, and it then only worked for 68 days, owing to an interruption near the African coast.

It was not repaired until the end of January, 1893.

When this company laid its cable, the Brazilian Submarine Company, convinced that they could maintain the monopoly they had enjoyed for 20 years, informed the Government that from August 16th, 1892, they would collect their charges, by reason of the fluctuations of exchange, at a rate equal to the average rate during the preceding month.

During the last three months of 1892, and the first two months of 1893, the public, by the above arrangement, were obliged to pay charges increased by 90 per cent., which later on was decreased to 60 per cent.

The rates had previously been calculated at the par rate of 24 pence, but as the company insisted that it was necessary to have a movable tariff, and after a request to make new arrangements in place of those of June 10th, 1879, which fixed the rate of exchange for the conversion of their collections into English currency, it was agreed on February 23rd to have a scale of rates varying as follows, viz., 12, 16, 20, 24, and 27 pence per milreis.

After the restoration of their cable, the South American Company continued to collect their charges at par, in order to bring about competition with the Brazilian Submarine Company, until that company reverted also to the par rate.

The effect of this competition was that the public profited to the extent of 100 per cent. on the rates which had formerly been levied by the Brazilian Company.

The Argentine and the Republics to the South, also profited by the above, and effected a saving of about 2,000 contos, or about 5,000,000 francs.

The Western and Brazilian and Brazilian Submarine Companies, for the purpose of preventing the increase of the traffic over the South American Company's cable, and in order to force that company to hand messages for places beyond Pernambuco to the Government lines, which are less prompt, refused the sender the right of indicating the route beyond Pernambuco.

Thereupon the South American Company, on December 14th, 1892, asked the Federal Government if, by Article 8 of the Decree, No. 5,270, of 1873, the Western and Brazilian were not obliged to accept and transmit telegrams handed to them at Pernambuco, or whether they had the right to refuse them as they had done up to the present moment.

On January 4th, 1893, the Minister decided that according to Article 8 of the Decree No. 5,270, of April 26th, 1873, the Western and Brazilian were only obliged to accept and transmit official and government telegrams.

The above mentioned article reads as follows:—

"The company agrees to accept and transmit government telegrams, private or official, to whatever station on their system they may be addressed."

The Bureau International when questioned upon the matter were of the opinion that according to the provisions of paragraph 3 of Article XLII., and of paragraph 1 of Article LXXXVI. of the Paris Regulations, the Western and Brazilian were obliged, even as non-adherents to the Convention, and by the fact that Brazil was an adherent, to conform to the instructions as to route indicated by the sender.

The conclusion to be arrived at from this opinion is that if the Western and Brazilian Telegraph Company had agreed with Brazil to receive and transmit only government telegrams, the regulations governing international traffic, on the other hand, forced them as a private telegraph company competing for international traffic, and operating in a state where there are different routes, to accept international telegrams having route indications, and to forward accordingly.

On the other hand, it is necessary to bear in mind that Article VI., of Decree No. 128, of April 11th, 1891, and Article 1, of Decree No. 965, of July 30th, 1892, forbids the South American Cable Company, without Government authority, to make any arrangements prejudicial to the Government service, or to amalgamate with other telegraph undertakings.

These restrictions were imposed on the company for the purpose of securing to the Brazilian landlines international traffic, and for this reason the Brazilian landlines, and the South American Company's cable, can only be considered from a traffic point of view as one system.

The Western and Brazilian cables may in a like manner be regarded as sections of these routes.

It is therefore evident that unrouted traffic arriving at Pernambuco by the South American Company must be sent by the landlines.

To ensure the carrying out of the above arrangement, a State official in the South American Cable Company's office at Pernambuco was instructed to send all unrouted messages by the landlines, and routed messages according to route indicated.

The State official in the office of the Brazilian Submarine Company was placed there to ascertain the amount of traffic passing over that company's cable, and to provide that route instructions were carried out.

It should be understood if no route is indicated, messages must be sent *viâ* the Brazilian landlines, and if routed *viâ* "St. Louis-Senegal," they must be handed to the South American Cable Company, and the proportions due must be handed by the Western and Brazilian Company to the South American Company.

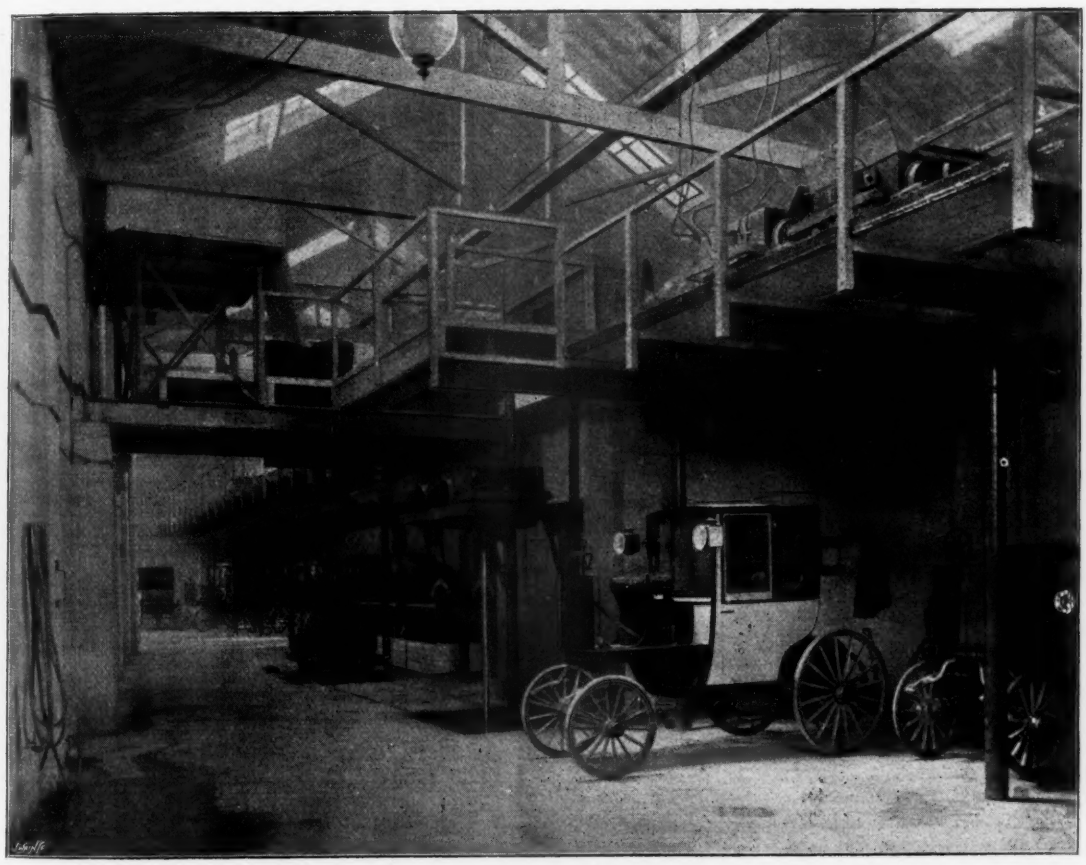
force that company to obey the orders of the telegraph administration.

In the mean while the revolution broke out, and the cables across the Bay of Rio Janeiro were cut, and the Government was obliged to employ the Western and Brazilian Telegraph Company to deal with all their traffic, as it was then very important.

The Western and Brazilian Company were thus unfortunately enabled to refuse messages handed to them by the South American Company, but not for long.

The Brazilian Submarine Company's monopoly was prejudicial to the Argentine Republic, and that Government notified the interested companies that if, after January 1st, 1894, the Western and Brazilian continued to refuse telegrams handed to them by the South American Cable Company addressed to places in the Argentine, they would give orders to their offices to refuse all telegrams routed *viâ* "Brazilian."

The result of this was that the Western and Brazilian Company



The Electrical Cab Company's Works.

The Government would not thereby infringe Article 8 of Decree No. 5,270, of April 26th, 1873, as all telegrams handed to the Western and Brazilian Company are thus treated as State traffic.

Articles XLII. and LXXXVI. of the International Service regulations would then be observed, and there would be assured to the landlines a great portion of the international traffic.

The two Government officials already in the offices of the two cable companies at Pernambuco would provide the above arrangements were properly carried out.

The above decision was communicated to the representative of the Western and Brazilian Company on July 19th, to be put into force on August 15th following, but he opposed it, and held by the decision of January 4th, claiming the right of his company to refuse to accept telegrams handed to them by the South American Company, or to hand them telegrams which had been routed by their lines.

Accordingly the Government hastened the completion of the fourth wire aforementioned in order to be able to deal with all traffic passing over the Western and Brazilian Company's cables, and in order to

gave way, and notified their stations to receive traffic of all kinds and for all destinations, however routed.

In the last report, the Brazilian administration treat on the difference of conditions affecting the exterior traffic passing over the State system as compared with that of the companies, and they also indicate probable causes.

To remedy defective service, it is thought necessary first to determine more precisely the classification of telegrams by altering Article 97 of the Regulations of June 30th, 1893, as follows:—

For the purpose of ascertaining the origin and destination of telegrams, they are classified as interior and exterior or international:—

1. Interior telegrams are those which originate from, or are destined for places situated in the country.

2. International telegrams are those which originate from, or are destined for places in other countries.

Further to provide uniformity in transit rates the following regulation has been adopted:—

I.—As regards the exterior service the Brazilian Republic is

divided into two zones: 1st, the North Zone, extending from the Amazon and Pará to the Federal capital, and 2nd, the Southern Zone, comprising places between the Federal capital and the frontier of Rio Grande du Sul, Paraná, and Matto Grosso. The branch lines of the interior of Minas Geraes, Sao Paulo, Matto Grosso, and Goyas are included in this zone.

II.—The rate per word for international correspondence is fixed at 400 reis for places within the limit of either zone, but it is increased to 600 reis for places beyond both zones.

III.—International telegrams received at Brazilian offices routed *viâ* Western and Brazilian, and those received from this company to be sent to their destination by land line, are liable to a rate of 200 reis per word to or from any office in Brazil to the nearest office of the Western and Brazilian Company.

IV.—The rate per word chargeable for international telegrams over the Brazilian landlines is fixed at 400 reis, whatever may be the distance of the State system traversed.

These conditions should equalise the conditions of all routes, and should enable the Government to compete for exterior traffic.

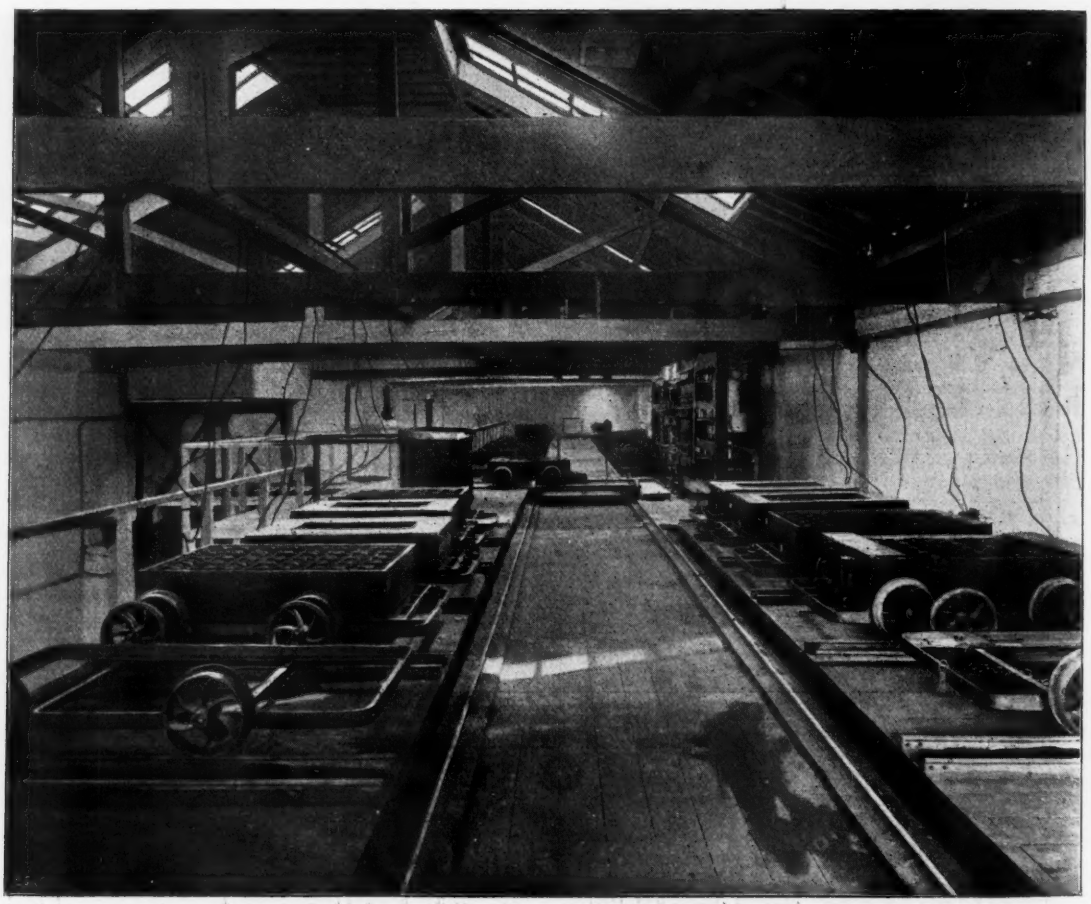
The Government also propose to put all companies on the same conditions.

(*To be continued.*)

BUSINESS NOTICES, &c.

Accumulator Works in Russia.—It is reported that negotiations are in hand with reference to the formation of a company to establish works in Russia for the manufacture of Tudor accumulators. The Hagen Accumulator Company, of Hagen, Westphalia, is reported to be interested in the project.

Statement of Affairs.—Under a receiving order made on July 7th last against William Marshall, described as of 16, Tokenhouse Yard, E.C., accounts have been submitted showing liabilities £12,945, of which £5,480 are expected to rank for dividend, with an estimated surplus in assets of £43,001, subject to realisation. It appears that the debtor was formerly in business in Australia, and from the end of 1893 until August, 1894, he was engaged in making a report upon mining properties in South America, on behalf of the Brazilian Government, receiving therefor a fee of £1,000. He subsequently came to England and commenced business as a mining and electrical engineer, with a capital of £1,500, at Tokenhouse Yard. He considers that his trading has been successful throughout, and he ascribes his present position chiefly to pressure by creditors, to loss in connection with the City of Mexico Tramways Company, and to his inability to immediately realise shares held by him in the London Electrical Omnibus Company (Limited). The first meeting of creditors stands adjourned until September 8th next, to enable the debtor to make arrangements with a view to paying the debts in full, and obtaining an order annulling the proceedings.



The Electrical Cab Company's Charging Gallery.

Auction Sale.—Messrs. Horne, Son, & Eversfield, will sell by auction on Thursday, September 2nd, at Cromwell Road entrance to the South Kensington Museum, by order of the Commissioners of H.M. Office of Works, &c., three dynamos, two with exciters, also various sundry articles, for further particulars of which see our "Official Notices."

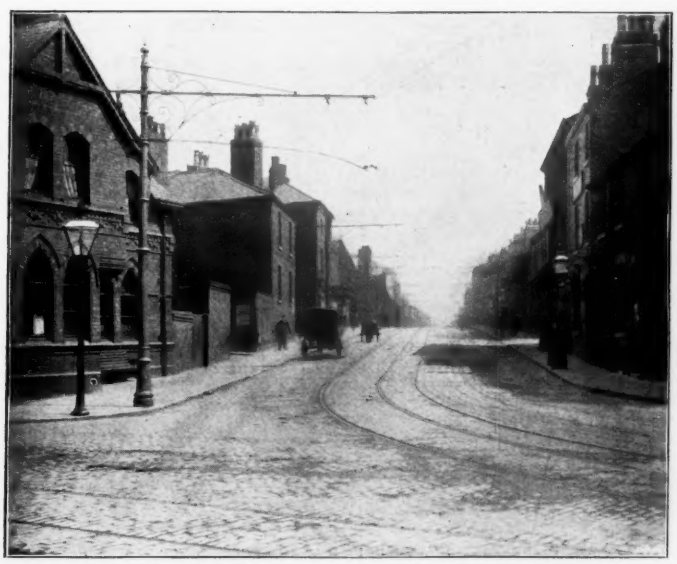
Automatic Stop for Machine Tools.—Mr. E. G. Herbert, of Cornbrook Park Tool Works, Manchester, is introducing a patent universal automatic stop. A self-acting tool which is not automatically self-stopping will break itself or injure the work if allowed to feed a moment too long; hence the man must stand idle all the time it is feeding, in order to be ready at the right moment to stop it and set the next cut. This idle time may amount to some hours a day on each machine, and it is claimed that this may be entirely saved by fitting the machine with the automatic stop. A machine so fitted stops itself at the end of the cut, and a bell is rung to call the attention of the workman. One man can in this way look after from two to six or more tools without risk or injury to work or machinery, and with a saving in the cost of labour varying from 20 per cent. to 80 per cent. as compared with the one-man-one-machine system. The stop consists of a "bell-crank lever," of which one arm is weighted, and the other arm is connected by a link to the belt-shifting gear of the machine. The manner of attachment is such that when the lever falls the belt is thrown on to the loose pulley, and the machine stopped. The action of re-starting the machine by hand raises the weighted lever, which is held up by a catch until again released. Meanwhile the machine may be started and stopped by hand in the ordinary way. The release of the lever is effected by an electro-magnet drawing back the detent, which holds the lever in position. The electro-magnet is connected by means of a flexible conductor to the contact block, which is placed on and (if necessary) bolted to the bed or other part of the machine, the needle being adjusted so as to touch the saddle, tool-box, or other traversing part when the latter has reached the position at which it is desired to stop the machine. The circuit is then closed, the lever falls, ringing the bell, and stopping the machine.

Fire.—A slight fire which occurred the other morning at the pianoforte establishment of Mr. M. S. Curtis, 28 and 29, Baker Street, W., is said to have been caused by "a defective electric light wire."

(*Continued on page* 280.)

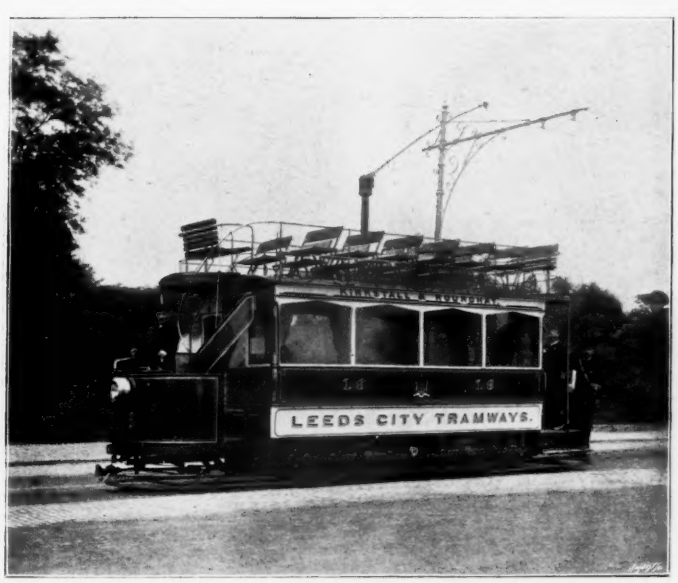
LEEDS ELECTRIC TRAMWAYS.

It is hardly necessary to refer to the history of tramway enterprise in Leeds except to mention the fact that the Corporation in the exercise of their municipal prerogative have acquired the whole of the tramways existing in the City of Leeds. That the system was of some magnitude even at the time of the transference of the undertaking, which occurred at the beginning of 1894, may be gathered from the fact that the capital expended by the Leeds Tramways Company was close on £80,000. The inhabitants of Leeds have for many years suffered from that most objectionable of urban complaints—the steam tram—hence it may be supposed that electric tramways with their noiseless and sumptuous appointed cars would have been received with general rejoicing, but the Yorkshireman is most conservative in practice, even in abolishing abuses, and the proposal to substitute electric cars for the existing double-decked structures was viewed with considerable disfavour.



The North Street Corner.

Unlike many Corporations, however, the Leeds Town Council had some practical experience of electric tramways, for had there not been running for some years the eminently successful electric line to Roundhay? The opening of this line takes us back to almost the beginning of electric tramway history in this country, yet it seems but a few months ago that we took part in that memorable inauguration ceremony. Those were the days of hitches, we never get them now, indeed the remark made by the Mayor of a certain town at the conclusion of an opening function that "the ceremony had passed off without the slightest *itch*" is almost typical of electrical undertakings at the present day.



One of the Cars.

There can be no denying the fact that the short section of electric tramline from Leeds to Roundhay has one way and another done a good deal for electric traction in this country. It is true that in the minds of many it served as a "horrid example," but in spite of the fact that the overhead wiring was done on a system that does not commend itself to one's approbation nowadays, the line showed not only the flexibility and the safety of electric traction, but it proved that on the score of economy it was infinitely superior to the other systems that were being used in the neighbourhood. There was always a difficulty in ascertaining what the real cost of working was at Leeds, and no doubt the contractors had some well-founded reasons for witholding information, but we have good grounds for saying that the total cost per car mile rarely exceeded 6d. Having regard to these facts it is not surprising that the Leeds Corporation should have decided when they acquired the tramways to adopt electrical working, and at the end of 1895 they instructed Dr. John Hopkinson to prepare a report for the working by electricity of certain sections of the tramway system.

Contrasting for a moment the type of plant on the old Roundhay line with the present machinery, it will be seen, in spite of all that has been said to the contrary, that American influence is, in Leeds at any rate, on the wane.

It is a little singular, having regard to recent discussions, that the engine formerly used in the power house of the Roundhay line was a Macintosh and Seymour; it was a single cylinder high-speed engine driving two dynamos by belts.

The old Roundhay Electrical Line.

American Engines,
" Dynamos,
" Motors,
" Cars,
English Boilers,
" Trolley wire,
American Switchboard,
" Trucks,
" Gearing.

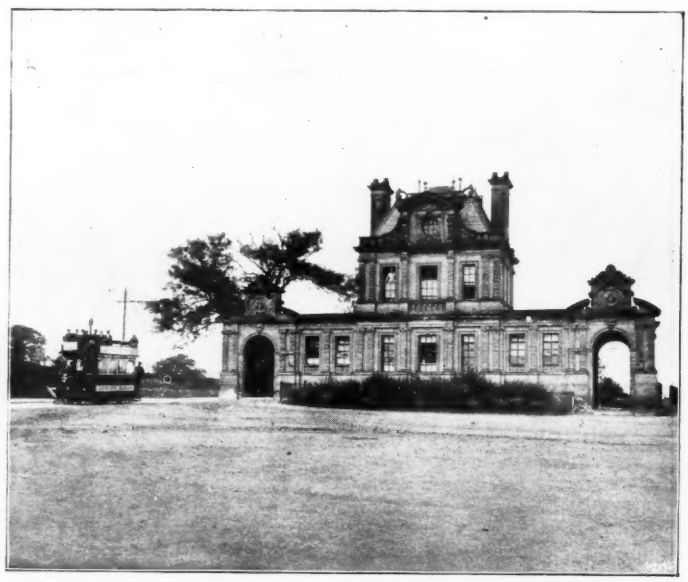
The New Line.

English Engines,
" Dynamos,
" Motors,
" Cars,
" Boilers,
American Trolley wire,
English Switchboard,
American Trucks,
English and American Gearing.

Returning to the report of Dr. Hopkinson, which was presented to the Town Council, the principal feature of this may be said to be the recommendation made for the use of accumulators, and before the close of this article we shall refer to this feature again. The present electric tramways are practically seven miles in length, and extend from Kirkstall to Roundhay, passing through the two main streets of the city, which, occasionally, are almost as crowded as London thoroughfares. It is quite evident that there is not

the slightest intention on the part of the corporation to limit their efforts in electric traction to seven miles, for we understand that in lately relaying many of the horse and steam lines the precaution has been adopted of bonding the rails, consequently, there are at the present moment some 30 miles of track which, so far as permanent way is concerned, is ready for electrical working.

The line from Roundhay to Kirkstall is double track throughout, and has in its length two or three fairly severe gradients and some distinctly sharp curves. One of the worst curves is at the junction of Boar Lane with Briggate, the radius being 55 feet; further up the line towards Roundhay occurs the sharpest curve on the line, the radius being 50 feet. This point marked the commencement of the former electrical line to Roundhay. The entire track on which the electric cars run has been relaid. The foundation for the rails consists of a concrete bed on which the rails weighing 100 lbs. to the yard are laid. The rails are of the usual girder section, and are grooved after the manner of tramway rails.



A Building partially utilised as an Accumulator Station.

The system of generation is the feature that next demands our attention, and as this possesses some special interest we will quote Dr. Hopkinson's reasons for adopting a system which differs in many respects from general tramway practice. It is hardly necessary to say that the chief novelty consists in the use of accumulators, and Dr. Hopkinson in his report says :—

> If the supply to the distant parts of the tramway system be effected solely by the agency of the central generating station, conductors will have to be provided of adequate size to carry, without undue loss of pressure, the whole 100 horse-power.

Centre Poles in Briggate.

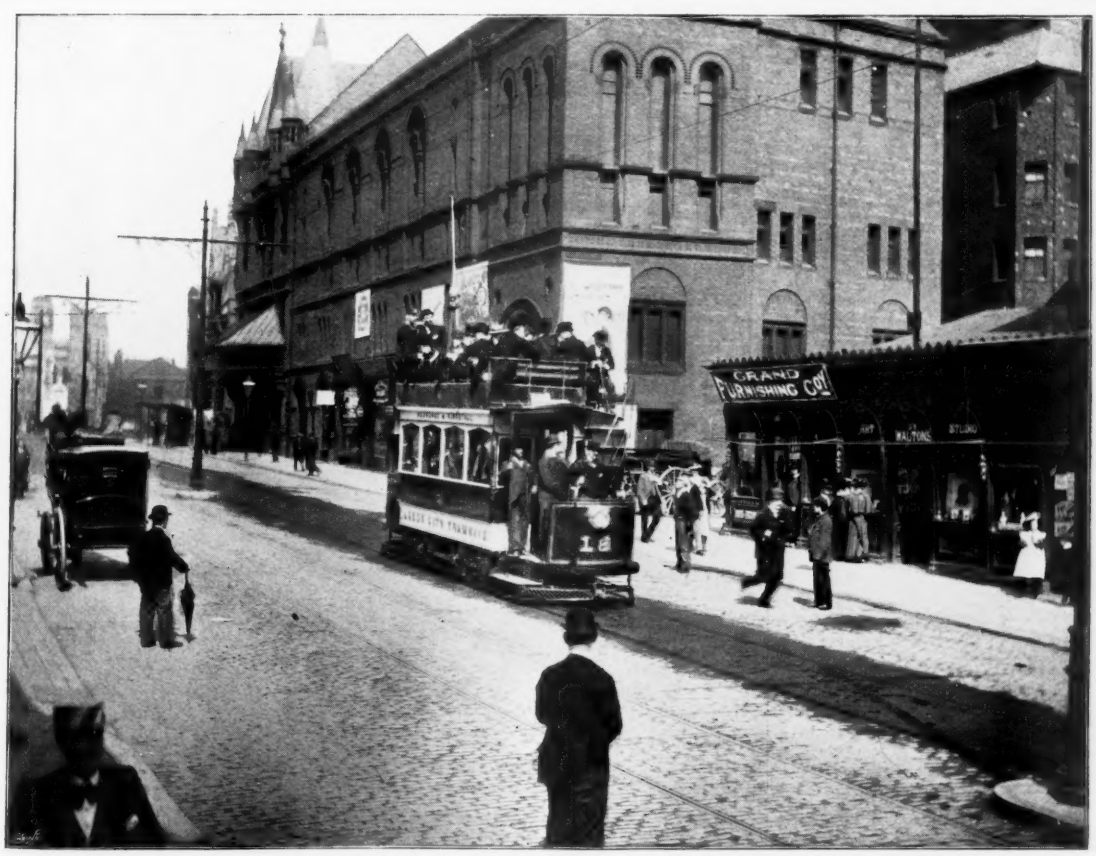
This can, however, be avoided by the proper application of accumulators. This application is precisely analogous to the familiar use of hydraulic accumulators for the hydraulic supply of power when the demand is variable. An accumulator would be placed in the neighbourhood of Roundhay, in any place which might be found convenient. This accumulator would be supplied with current from the generating station, the current being practically constant. Whenever the heavy drain of 100 horse-power in its neighbourhood was required, two-thirds of this power would be supplied by the accumulator, exactly in the same way as when many presses are required to work at once; the water is supplied to them from the hydraulic accumulators. The space required for such an accumulator would not be large; a room 20 feet square would be sufficient, if more were not available. A second accumulator would be placed towards the Kirkstall end of the line. It would be in all respects a duplicate of the accumulator at Roundhay. The accumulators would be worked under favourable conditions, as they would at all times be almost fully charged. Working under the less favourable conditions of electric lighting, accumulators can be maintained, by contract with the manufacturers, for less than 10 per cent. of their actual cost, and even at this rate, it is more economical to maintain one's own accumulators, if the management is reasonably careful. These batteries of accumulators would not require the constant attendance of a man; they would really work automatically, just as hydraulic accumulators do; they should, however, be frequently inspected. Accumulators have been used with very great advantage in the remarkably successful tramway from Douglas to Laxey, in the Isle of Man, and under conditions analogous to those of Leeds. If the only question were that of the tramway from Kirkstall to Roundhay Park, I should recommend a third accumulator in the neighbourhood of the power station, because even there the variation in load would be very considerable. But one must look at the probable future development. When there are several tramlines, all converging upon Boar Lane, the average effect of the larger number of cars will be felt, and the load will consequently vary very much less. There is another incidental advantage of the use of accumulators on the more distant portions of the line. It makes it much easier to conform to the Board of Trade regulations, which require that the difference of electrical pressure between the remotest parts of the line and the generating station shall not exceed 7½ volts. If accumulators are used, it is only necessary to provide such return conductors, be they rails, or be they specially provided, as will be sufficient to carry the average return current with less difference than 7½ volts. If, on the other hand, accumulators be not used, it is necessary to provide conductors for the return, of adequate size to carry the maximum current, which, as already stated, is three times as large as the average current. Another advantage in the moderate use of accumulators, is that they provide the means of moving a few cars along the line, or in the depôts, even when the engines are standing. This would shorten, to a certain extent, the hours during which it would be necessary to run the generating machinery. I would have it understood, however, that though I am perfectly clear that accumulators will be a great advantage in work-

ing this tramway, I do not consider them by any means an absolute necessity. The line could be worked without them undoubtedly, but with less economy.

The power house is situate in Crown Point Road, adjoining the River Aire, and is practically central to the tramway system; it possesses means of obtaining an ample supply of condensing water, and coal can be brought alongside the works by barges. The machinery is housed in a well designed building some 50 feet in height, and is divided into boiler house, engine room, and economiser room. The steam raising plant consists of two Lancashire boilers made and erected by Messrs. Clayton, Son & Co., of Leeds; they are fitted with Bennis stokers, and, when the boiler room is completed, coal storage bins will be fixed so that a constant feed is effected into the hoppers. An electrical conveyer will be employed for carrying the coal from the barges to the storage bins. A Green's economiser, consisting of 192 tubes, is also in use. The tubes are arranged in two groups coupled together with copper expansion elbows at top and bottom. It will be seen from our illustrations that the engines and dynamos are arranged in a manner that differs from the usual methods.

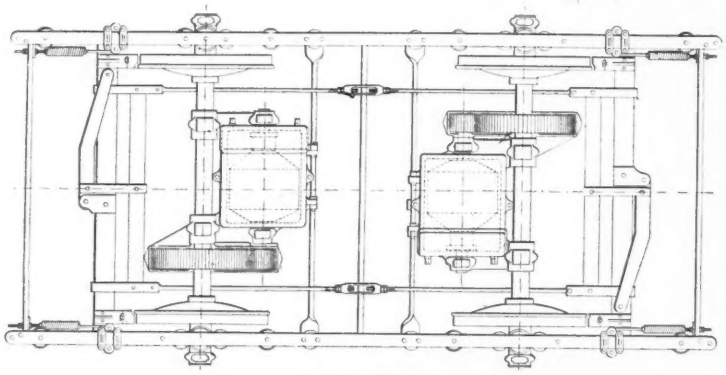
A View on the Roundhay Road—Trolley Poles versus Telegraph Poles.

The engines are arranged at opposite ends of the building, and drive by ropes, dynamos placed in the middle of the floor. The engines are of the coupled compound horizontal condensing type, and are made by Messrs. John Fowler and Co. The high pressure cylinder is 18½ inches diameter, the low-pressure cylinder 32 inches diameter by 2 feet 6 inches stroke. Both cylinders are fitted with main and expansion valves of the piston type, the expansion valves of both cylinders being controlled automatically by the governors. The governors are driven by spur gearing, the pinion being made of pressed raw hide. The speed of the engines is 100 revs. per minute. The fly-wheels are 15 feet diameter, and are grooved for 15 ropes 1¼ inches diameter, cotton ropes being employed. The weight of the fly-wheels is about 19 tons each. The engines are capable of giving 400 horse-power each with a boiler pressure of 120 lbs. The terms of the contract specify that the steam consumption must not exceed 21 lbs. per horse-power.



The Opening Day—Mr. Ritchie Sprinting.

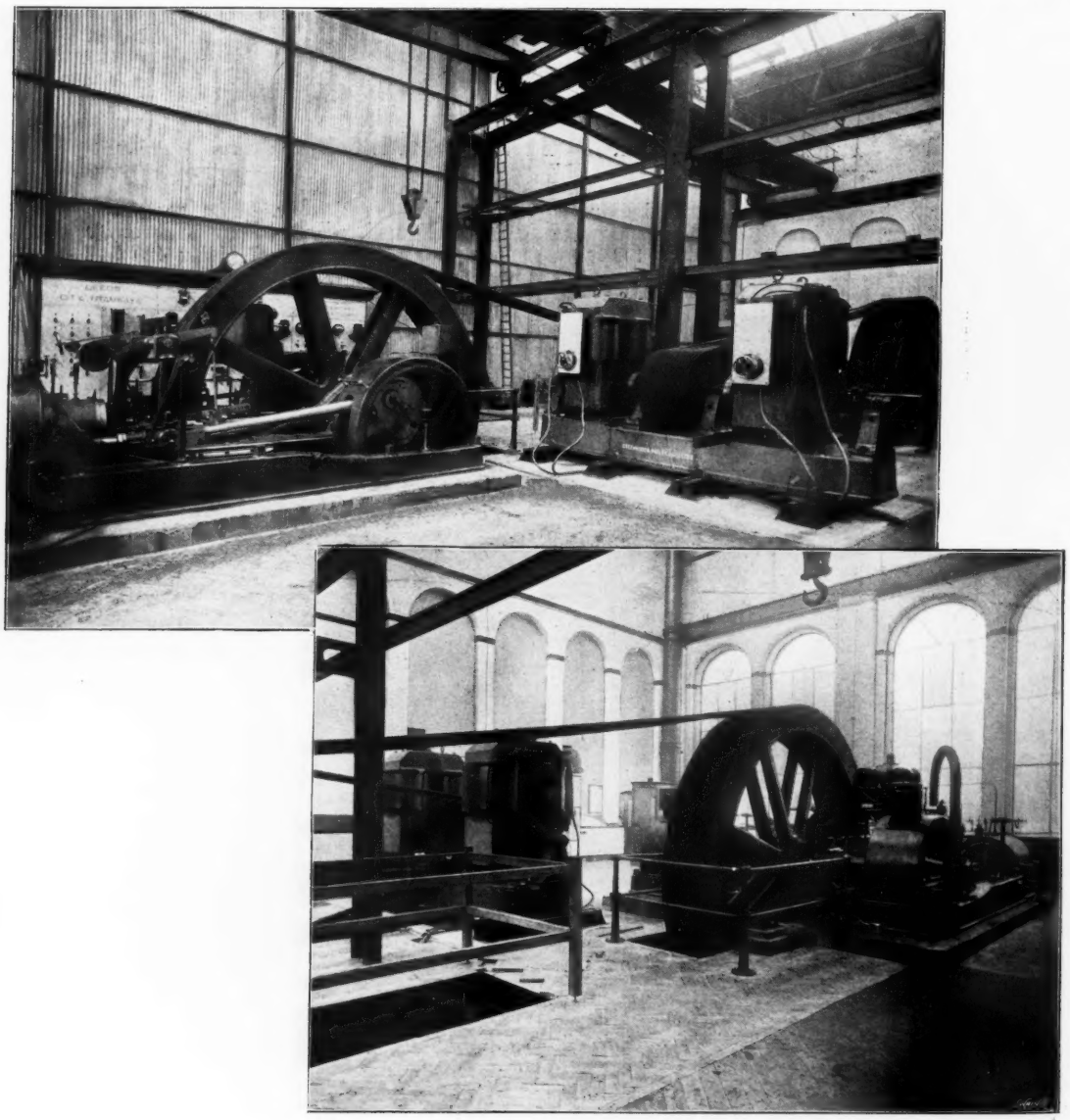
The air pumps are fixed below the floor at the back of the low pressure cylinder, and are worked by an L lever connected by links to the low pressure piston rod. The air pumps are single-acting; the condensing water is obtained from the river Aire, being first passed through a series of gratings before being used for condensing purposes. For priming the condensers and for cases of emergency the town supply is also connected.



Plan of Truck.

The generators, by Messrs. Greenwood & Batley, are two in number, each consisting of two armatures and two sets of magnets on one bedplate, the armatures being coupled together and driven by one rope pulley between the two. Each armature generates 200 to 250 amperes at 500 to 600 volts, at a speed of 450 revolutions per minute. The magnets are compound wound and each set of magnets is provided with a switch by means of which the series winding of the two magnets may be put in series, parallel or entirely cut-out. The brushes are of wide carbon covering three to four sections of commutator. Before going out these machines were tested by Dr. Hopkinson as follows:—

One armature of a generator was used as a dynamo supplying current to the second armature which ran as a motor, the latter supplying the mechanical power to drive the former; in series with these armatures a third machine was used supplying the excess of potential required by the motor over the generator. The fields were separately excited. The machines were so adjusted as to give 200 amperes at 500 volts at a speed of 450 revolutions. The specified efficiency of the combination was to be not less than 87 per cent. At the



Two Views of the Power House.

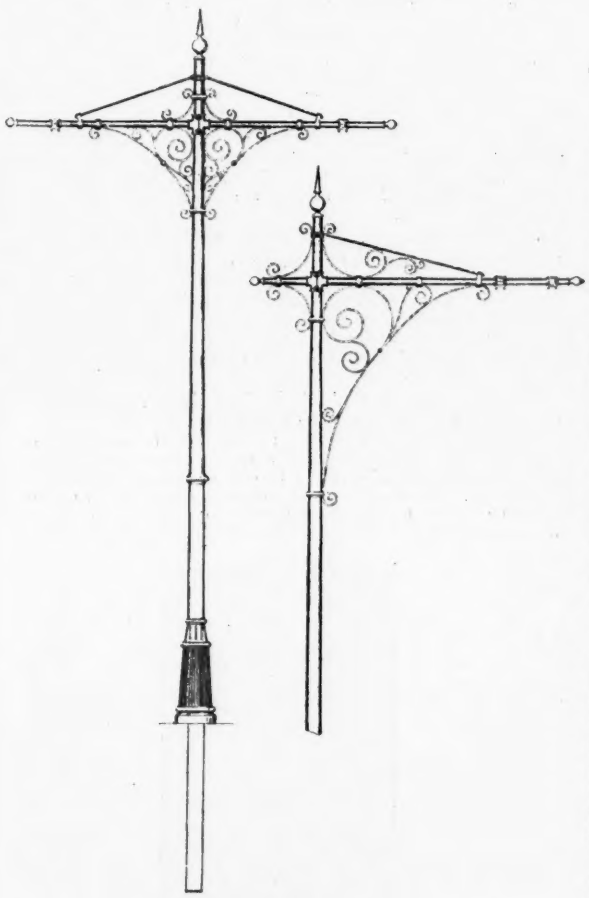
test, a combined efficiency of 90·7 per cent. was obtained, which gives an efficiency of 95·35 for each machine, this test being taken when hot after a full load run. The terms of the contract set forth that a bonus will be given for every one per cent. efficiency over that specified, so a considerable sum will be handed over to the contractor as bonus.

There are in the engine house two overhead travelling cranes which are worked by hand. The switchboard, which is rather a striking piece of work, contains the usual equipment necessary in a traction power house. The board is divided into various panels, four being for the machines and the rest for the feedeers and the Board of Trade instruments. A large Ferranti meter records the amount of current leaving the station, and there are Weston ammeters and voltmeters recording the condition of the various sections.

The Outside Work.

The various illustrations readily show the style of the overhead construction. It will be seen that both centre poles, with double arm brackets, are employed in some of the streets, while in the roads outside the town and in some of the outlying streets, side poles are common. The standards, which are of tubular steel, are of elegant design and have been made by Messrs. James Russell & Sons, of Wednesbury. The height of the poles is 31 feet, and those at the side of the road are 120 feet apart.

The overhead conductor has a complete length of about 12,000 yards and is heavier than that usually employed on

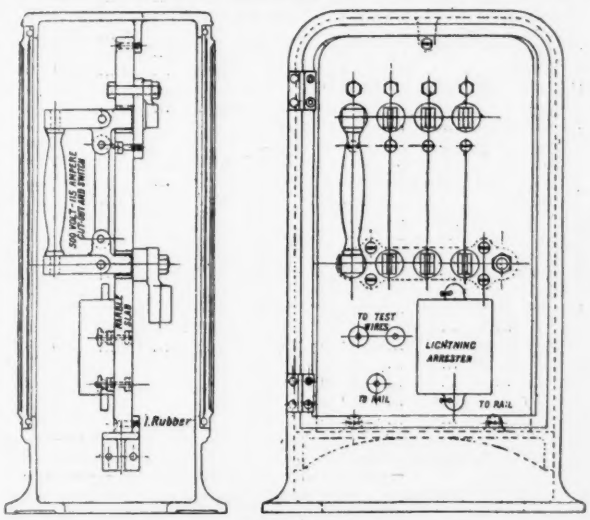


Centre and Side Poles.

overhead work, measuring 0·4 inches diameter, the whole of the overhead work having been supplied by Messrs. Laing, Wharton & Down. Following the conditions of tramway working laid down by the Board of Trade, the overhead wire is divided into half mile sections.

There are section boxes at every half mile, which are placed underground in the streets, and, outside the city streets, are placed at the sides of the road. These boxes merely contain the plugs for breaking or joining the sections and lightning arresters. The feeder cables are of the Diatrine type made by Messrs. Glover & Co., and laid in Doulton conduits.

There are two batteries of accumulators, one at each end of the line, these being supplied by the Chloride Company. The Roundhay battery has been arranged in one of the Lodges at the entrance to the Park, and consists of 256 chloride cells of 15 plates each. This battery is capable of delivering into the line 160 amperes. The battery at Kirkstall, which has been arranged in a specially designed building, has exactly the same number of cells as



Section Box.

the Roundhay sub-station, but each cell has a smaller number of plates, eleven only being in the cells. We shall have something more to say on the subject of these cells in a subsequent article on the Leeds Tramways.

Before bringing this preliminary notice to a close we must not omit to refer to the cars, ten of which are now running. Our readers will be disposed to agree with us that the cars are exceedingly elegant. The bodies have been made by Messrs. Milnes & Co., of Birkenhead, and the Peckham cantilever trucks and trolley pole, Chicago bonds, and accessories by Mr. R. W. Blackwell, the motors and gearing by Messrs. Greenwood & Batley.

Each car is driven by two Greenwood & Batley motors giving 10 to 15 H.P., one motor driving each axle. The motors are steel clad of the four pole type, series wound, with the magnet winding on two poles. The bottom coil is enclosed in a covering of lead and is absolutely watertight. The top half of the motor frame can be lifted off from inside the car so that armature or coils may be readily examined in position or replaced. The armatures are of notched type, with 105 notches and 12 wires for each notch. The brushes are of carbon set at 90°. The axles are driven from the motors by single reduction gear, ratio 47 to 1. The gear runs in oil and is enclosed in a malleable iron gear case, and runs absolutely noiseless. The speed of the cars is regulated with series parallel controllers fixed at each end of the car and fitted with emergency brakes. The speed of motor shaft at the highest speed allowed, viz., 12 miles per hour, is 638 revs. per minute. The trolley pole is of the swivelling type patented by Mr. Philip Dawson, and previously described in these columns.

The work has been carried out under the personal supervision of Dr. John Hopkinson and his assistant, Mr. E. Talbot, Mr. Burbridge, the city electrical engineer, acting as clerk of the works.

There are other details of the line, which will be referred to in a further article.

We are indebted to Messrs. Greenwood & Batley, and other contractors, for much of the foregoing information.

Glasgow and West of Scotland Technical College.—From an "Official Notice" in this issue it will be ascertained that the 1897-8 session at this college commences on Monday, October 4th.

BUSINESS NOTICES, &c.

(*Continued from page 274.*)

Electrical Wares Exported.

Week Ending Aug. 24th, 1896.	£	s.
Albany. Teleg. mat. ...	211	0
Auckland	35	0
Barcelona	390	0
Bilbao	7	0
Bocca. Teleg. poles ...	255	0
Bombay	36	0
Boulogne	8	0
Christiana. Teleg. wire	50	0
Calcutta...	47	0
Cape Town	235	0
Copenhagen. Teleg.cable	2,500	0
Demerara	20	0
Flushing	10	0
Fremantle	72	0
„ Teleg. mat.	601	0
„ Teleph. mat.	68	0
Hong-Kong	12	0
Koroor. Teleg. cable...	5,000	0
Las Palmas	80	0
Mauritius. Teleg. stores	231	0
Melbourne. Teleph. mat.	327	0
„ Teleg. mat.	752	0
Oporto. Teleg. mat. ...	58	0
Perth	10	0
Port Elizabeth	43	0
Rotterdam	40	0
Spezzia	50	0
Sydney	320	0
Wellington	30	0
Total	£11,498	0

Week Ending Aug. 24th, 1897.	£	s.
Adelaide	46	0
Amsterdam	70	0
Antwerp	150	0
Auckland	285	0
Bangkok. Teleg. mat. ...	288	0
Boulogne	160	0
Buenos Ayres	10	0
„ Teleg. mat. ...	10	0
Calcutta...	664	0
Cape Town	352	0
Colombo	6	0
Copenhagen	6	0
Durban	187	0
„ Teleg. mat. ...	57	0
East London	23	0
Flushing	70	0
Hamburg	248	0
Malaga	75	0
Melbourne	35	0
Montreal	500	0
Novocossisk	600	0
Port Elizabeth	420	0
Shanghai. Teleg. mat.	34	0
Singapore. Teleg. mat.	12	0
Sydney	500	0
Total	£4,808	0

Foreign Goods Transhipped.

	£	s.
Fremantle. Electric bells	9	0
Passages...	130	0
Total ...	£139	0

	£	s.
Calcutta...	420	0
Total ...	£420	0

Dissolutions of Partnerships.—Messrs. A. Blackburn, J. Walker and J. H. Pinder, hitherto carrying on business as electrical engineers at Upper Lane Mill, Cleckheaton, under the style of Blackburn, Walker & Co., have dissolved partnership by mutual consent, so far as concerns J. H. Pinder, who retires. Debts will be attended to by A. Blackburn & J. Walker, who will continue the business under the old style at Cleckheaton.

The partnership hitherto existing between H. C. Ashworth and C. E. Lomax, carrying on business at 8, Fleet Street, Bury, as ironmongers and electrical and heating engineers, under the style of H. Ashworth & Co., has been dissolved by mutual consent. Debts will be attended to by C. E. Lomax.

Catalogues.—The International Electric Company, of Redcross Street, E.C., have brought out a new catalogue of over 100 pages of well-printed, illustrated and general matter regarding their supplies. Switches and switchboards of various types, cutouts, fuse boards, incandescent lamps, wires and cables, electroliers, brackets, and other fittings, dynamos, alternators, and motors, and a great quantity of other machinery, apparatus, and accessories for use in connection with electric lighting and power work.

Electric bells, telephones, electric light apparatus, and the sundry fittings and accessorial parts used in these branches of electrical work are dealt with in an illustrated price list of 110 pages which has just been issued by Messrs. Croggon & Co., Limited, of Upper Thames Street. The book, which has thick cardboard covers, includes Sections B and E of the firm's catalogues. An important feature of the electric light supplies section (E) is a set of diagrams and instructions for interior wiring of houses.

The Southgate Engineering Company, Limited, whose works are situate at New Southgate, have sent us copies of the lists of machine tools and cranes. In the machine tool list we observe illustrated descriptions of screwing and tapping machines, lathes of various kinds, shaping, planing, punching and shearing, vertical milling, boiler drilling, pumping, and other machines as made by them. The crane catalogue deals in a similar manner with permanent way, overhead travelling and Goliath cranes, setting crabs, steam loco., portable derrick and other cranes, winches, &c. The illustrations are numerous.

From the Union Elektricitaets-Gesellschaft of Berlin we have received a small pamphlet, very neatly arranged and printed in German, describing certain electric tramway systems on the Continent with the construction of which they have been connected.

Illustrated price lists of the Acme dynamos and motors of the drum and ring armature types have been issued by the Acme Motor and Traction Company, of 72, Finsbury Pavement.

A new price list of Messrs. Johnson & Phillips's cables has been issued. We understand that the compiler has endeavoured to so arrange the various sizes of conductors and types of insulation that they may be easily followed and understood. The list commences with details as to bare copper wire, which, with the various qualities of insulating material, is manufactured into cable suitable for the numerous requirements of the trade, such as aerial, pure rubber, vulcanised rubber insulated, of 300, 600, 2,000, and 5,000 megohms per mile. The conductors are also arranged in order of sectional copper area, instead of the old-fashioned way of grouping all single, three, seven, 19, 37, &c., strands separately; thus for a short run a 37/16 will answer the same purpose as a 19/13, and save the contractor proportionately at the same rate of £10 per mile. During the year the firm has largely increased its depôts for the supply of cable at London, Manchester, Glasgow and Brussels.

Messrs. Davey Paxman & Co. have issued a catalogue, dated June, 1897, of engines, boilers, and other machinery manufactured by them at Colchester. Portable and semi-portable steam engines, under-type engines and boilers, horizontal and vertical fixed engines of various types, the "Windsor" three-cylinder vertical engine, with dynamo combined, winding, hauling, pumping, hoisting, and other engines, also Lancashire, Cornish, the Economic, water-tube, multitubular, marine, and other types of boilers, Paxman's patent expansion boiler flue, and various other similar lines, are described and illustrated in this list of about 120 pages.

Dynamo Brushes.—Messrs. Le Carbone, of 7, Carteret Street, S.W., have been appointed sole agents for the United Kingdom and Colonies for Mons. L. Boudreaux's foliated rolled metal dynamo brushes, which are made of anti-friction metal.

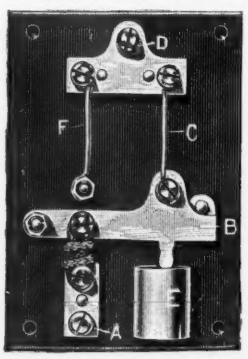
Electrical Engineering in Holland.—We learn that the Constantia Incandescent Lamp Works, of Venlo, have just altered their title to the Constantia Electric Works. Hitherto only incandescent lamps have been made at these works, but arrangements have been made to manufacture all kinds of electric apparatus.

Enamel Rheostats.—The Ward-Leonard Electric Company, of Hoboken, New Jersey, have just issued from the press their ninth catalogue, dealing with enamel rheostats and the Carpenter and Ward-Leonard types. We understand that it is just five years since the first enamel rheostats were placed on the market by this company, and the business has gone on steadily increasing. The company (which is represented in England by Messrs. Veritys, Limited, and in Berlin by Messrs. S. Bergmann & Co.), has standardised many hundreds of rheostats for use as field regulators, motor starters, theatre dimmers, ventilating fan regulators, &c. In the catalogue before us are illustrated descriptions of various types of round field rheostats for front of board, spring starters, motor starting rheostats, universal automatic rheostats, automatic circuit breakers, ventilating fan speed regulators, theatre dimmers, reversing controllers, and standard resistance plates. A great feature is a very complete cable code index, giving a word for each article particularised.

Gas.—An alarming explosion occurred on 20th inst. at St. Bede's College, Manchester. The room in which the explosion took place was completely wrecked, a portion of the roof of the building was blown off, and most of the windows of the establishment were shattered.

"Ideal" Engines.—The Goldie & McCulloch Company, Limited, of Galt, Ontario, Canada, send us a tastefully got up little publication of 30 odd pages, in which their "Ideal high art" engines are beautifully illustrated and explained, and the good points brought forward. There are some comments on lubrication, economy in compounding, governing, and other interesting matters. Tables of general foundation and dimensions in inches of the Ideal engine appear at the end of the book.

New Fuse.—Mr. F. J. Borland, of Leeds, has placed on the market a patent automatic fuse for use in theatres, hotels, or other public buildings, when the interruption of the lighting consequent on fuse blowing would be a matter of moment. With this fuse the interruption is, except in case of serious accident, only momentary. The current passing through the terminal, A, is conveyed by the bar, B, through the fuse wire, C, and thence by terminal D. In the event of a short circuit the wire, C, will fuse, allowing the



bar to drop by its own weight, thus completing a new connection through a mercury cup, E, to the fuse wire, F, which is slightly heavier, and restoring circuit. In the event of a serious short circuit, the attention of the attendants would be at once drawn by the extinction of the lights, consequent on the blowing of the second wire. The fuse board can also be connected to signal by means of lamp or bell when the first fuse blows.

Railway Officials.—"The Universal Directory of Railway Officials" for the year 1897 has just been published by the Directory Publishing Company, Limited, of 8, Catherine Street, Strand, W.C. The object of the work is shown in its title. The information is compiled from official sources by Mr. S. Richardson Blundstone, editor of the *Railway Engineer*.

Reconstruction.—At meetings of the Electrical Advertising Syndicate, Limited, held at 164, Gresham House, E.C., on August 4th and 19th, resolutions were passed winding up voluntarily, for the purposes of reconstruction, and Mr. J. W. Jefferies, of that address, was appointed liquidator. The new company will bear the same name as the old.

The Jandus Lamp.—We understand that the Jandus arc lamp has been adopted for the lighting throughout of Messrs. Jones and Higgins's premises at Peckham. Trials were made with both the Jandus and another type of lamp, with the result that Messrs. Jones and Higgins have ordered nearly 300 from the sole agents, Messrs. Drake & Gorham. We are informed that this installation, and that at the Linotype Company's new premises, near Manchester, will be among the finest isolated arc lamp installations in England.

The Wellington Indestructible Ignition Tubes.—The Motor Development Corporation, Limited, of Tower Works, St. George's Square, Regent's Park, N.W., have secured the rights and obtained the services of Mr. F. F. Wellington, and staff of the Indestructible Ignition Tube Syndicate, Limited (now in liquidation), and is prepared to supply the syndicate's customers with all goods as heretofore. We understand that upwards of 9,000 of these ignition tubes have been sold.

ELECTRIC LIGHTING NOTES.

Ayr.—The extensions are being pushed on as quickly as possible, but the electrical engineer does not anticipate delivery of the engines and alternators until the engineers' strike has ended.

Bradford.—The Gas and Electricity Committee recommends the Council to increase the salary of Mr. Samuel Dalton, the assistant electrical engineer, from £200 to £250.

Brechin.—A deputation has been visiting Shrewsbury, Salisbury, and other places, for the purpose of inquiring into the working of the electric light installations there.

Cork.—The Town Clerk has received the approval of the Board of Trade to the deed transferring the powers of the Carporation in respect of electric lighting to the tramway company.

Country House Lighting.—An installation of electric light has just been completed at Delnabo House, Fomintoul, the residence of Colonel Smith. The power is supplied by means of a turbine driven by water carried in a lade from the Ailnac. The contract was carried out by Mr. Middleton.

Devonport.—The Council is considering the propriety of appointing a Committee to exercise the powers of the Corporation's Electric Lighting Order of 1896.

Dinnet.—An installation of electric light at Dinnet House has just been completed by Mr. Harvey, the new proprietor of the estate of Dinnet. The power necessary for the production of the electricity, according to a Scotch daily, has been secured from a turbine driven by water derived from the small stream which runs out of Loch Kinord. This stream has been tapped at a point close to the village of Dinnet, and a conduit laid thence to the bank of the river Dee a little to the west of the Established Church manse.

Dunoon.—Dunoon Pier was lighted with the electric light last Saturday night for the first time. The only other pier on the Clyde which is lit with electricity is Tichnabruaich.

Electric Lighting at the Houses of Parliament.—Workmen are now engaged in completing the installation of the electric light at the Houses of Parliament. Electricity reigns supreme in the dining rooms, lobbies, and corridors, and its use is gradually extending to the committee rooms. On the Peers' side, the Royal Gallery is being treated in a similar manner, and the dining room and grand committee room will be attended to in due time. Throughout the entire building there are no fewer than 5,000 lights.

Folkestone.—A member of the Council suggests that that body should take steps to ensure that the electric light company shall have the supply available some time during the next 18 months.

Glasgow.—The question of acquiring suitable sites for the erection of additional works for the supply of electrical energy within the entire municipal area has been under the consideration of the Electricity Committee.

Greenock.—At a recent meeting of Greenock Police Board the sub-committee appointed to consider the question of electric lighting reported that they had met with the Gourock and Port-Glasgow committees, and had agreed to recommend that a joint committee be appointed to obtain full information on the subject, and that power be granted them to visit installations in the country. The report also recommended that an engineer be appointed to visit the three burghs and advise as to the best means of utilising motive power, &c.

Hampstead.—The work in connection with the lighting of High Street, Heath Street (new portion), Rosslyn Hill, and Haverstock Hill by means of electric arc lamps is progressing rapidly. The Hampstead Vestry sanctioned the work in February, and, taking into consideration the varying conditions of the roads to be lighted, decided upon placing 28 arc lamps at the sides of the roads. The Vestry decided to adopt as the most suitable the Crompton-Pochin arc lamps, at £8 11s. each. These lamps will be placed on lamp-posts and carriers made by Messrs. Kershaw, of Nuneaton, at a cost of £8 15s. each. This extension of the system entailed the provision of new plant at the Central Station (which has recently been nearly doubled in size). This plant should, according to the arrangements then made, be delivered and fixed in position by November, but it is feared that the engineers' strike may delay the completion. The installation of the new machinery is being made under the superintendence of Mr. G. H. Cottam, the Vestry's chief electrical engineer, and the work of laying the mains, making the connections, and fixing the standards and lamps is being executed under the superintendence of Mr. E. Sayer, the chief assistant engineer. By an arrangement with the adjoining parish of St. Pancras, whose Vestry was the first in London to undertake the responsibility of directly providing electricity, the portion of Haverstock Hill which lies between Eton Road and Adelaide Road, will also be lighted by electricity, so that, when the work is completed the whole of the main thoroughfare from a point a little north of Oxford Street to the Fire Brigade Station in Heath Street will be lighted by electricity. The whole will form the longest line of electric arc lamps to be found in the metropolis, as, according to the *Hampstead Express*, it will extend over a distance of considerably more than three miles.

Hebden Bridge.—The Hebden Bridge Co-operative Society has given the contract to Mr. R. S. Blackburn to put down an electric lighting installation for its premises. There will be a 40-H.P. gas engine driving direct a 400-light dynamo, also a 12-H.P. gas engine driving a 120-light dynamo. There will be six 2,000-C.P. arc lamps for the exterior lighting, four arcs for the hall, and 286 incandescent lamps for the remainder of the premises.

Kingswood.—The District Council last week adopted a report of the Lighting Committee recommending an extension of the electric lighting area so as to include a number of specified thoroughfares. It was agreed not to apply at present for a provisional order as to underground wires.

Laundry Lighting.—The Godalming Sanitary Steam Laundry Company have had a complete installation of the electric light placed on their premises in accordance with specifications prepared by Mr. F. Fanta, and executed by Messrs. Carling, Gill and Carling. The requisite power is obtained from the steam engine which drives the other machinery. The installation is sufficient for 121 lamps. Owing to the safety of the light, it has been found possible to introduce it into the airing rooms, where the dry inflammable material is stored, and this has proved a great boon, as the sorters can now use the rooms as freely at night as in the daytime, the work being thus considerably facilitated.

Leeds.—The Yorkshire House-to-House Electricity Company are, according to the *Leeds Mercury*, making extensive preparations to meet the demands for current expected during the coming winter. Their new buildings are now rapidly approaching completion, and the additional generating plant, consisting of four new Lancashire boilers and four combined engines and dynamos, each of 500 indicated horse-power, have been obtained. The company now direct attention to modifications in the system of distribution, which have been approved by the Board of Trade, and which are being carried into effect at a large expense. It is stated that not less than £10,000 is being spent this year in improving the means of distribution in a part of the centre of the city, and the new system will be extended to other central thoroughfares as quickly as circumstances permit. Some slight economy is expected to accrue to the company, but the main object of the change is to add still further to the efficiency and constancy of the supply of energy and the convenience of the customers. Hitherto all the company's cables have conveyed electric current at high pressure, and the conversion to low pressure is done by a separate transformer on the premises of each consumer. Under the new system, transforming sub-stations are constructed at various points in the centre of the city, at which the conversion of the current from high to low pressure will be effected by means of large transformers to be there installed. Up to the present, four of these underground structures have been built, two in Albion Street and two in Briggate.

Liverpool.—The electrical engineer's monthly report submitted to last week's meeting of the Lighting Committee, stated that on the 31st ult. the equivalent number of 16-C.P. lamps connected with the supply mains was—for private lighting 53,098, for Corporation lighting 4,878, making a total of 57,976, showing an increase of 640 for the month. The number of units supplied to private consumers during the month was 64,062, and to public lamps 16,654—total, 80,716, as compared with 52,723 during the month of July, 1896. The committee decided to extend the electrical mains in Smithdown Road at an estimated cost of £75, in Tithebarn Street at £144, and in Canning Place at £68.

Llandrindod Wells.—The works of the Electric Light and Power Company have been practically completed. The installation for house lighting has been proceeding since Easter. Last Saturday night the whole of the electric street lamps, about 70 in number, were lighted for the first time. The installation was perfectly successful. The actual lighting commenced on Monday. The system has been arranged and carried out by the engineer in charge, Mr. Bertram Thomas, of Manchester.

Newington.—A meeting was held in the Newington Vestry Hall some days ago, when the electrical engineers (Messrs. Kincaid, Waller & Manville) were instructed to prepare detailed drawings and specifications of the generating station and plant required, in order that the Vestry, immediately after the recess, may have the scheme before them, to press on with it.

Portsmouth.—At a meeting of the Electric Lighting Committee on Wednesday, Alderman G. Ellis, J.P., chairman, reported the results of his efforts to obtain additional plant to meet the demands of the consumers during the coming winter. The strike in the engineering trade has seriously delayed the completion of the new machinery ordered some months ago. The chairman had been authorised to seek the loan of a new dynamo, and he had ascertained that the British Thomson-Houston Company had a spare dynamo in Berlin, which they had generously offered to lend to the Corporation for six months, for £100, to cover the bare cost of the removal and return, and the renewal of the worn parts. The output of the machine will be sufficient for about 2,000 lights, and will, it is believed, just enable the Committee to get through the winter with present customers, but will not justify them in taking on any more. After carefully reviewing the existing situation, the Committee, by a unanimous vote, resolved to ask the Council to sanction the borrowing of £40,000 for further works. The whole of the sum is not likely to be required for some time to come, but it was deemed advisable to take this course, instead of obtaining it piecemeal. It is estimated that about £21,000 will be required next year, the chief items of the expenditure being for new boiler house, shaft, economiser, coal store, means of conveyance direct from the ship, and new mains for sea water for condensing purposes. In 1899, it is thought a new engine, to cost about £9,000, will be required, and £10,000 will be left for contingencies.

Thetford.—The freehold electrical light and power station, with complete plant, apparatus, mains, &c., have been sold by auction by order of the liquidator (Mr. Lovewell Blake). The premises contain all the apparatus for generating the electric light; the overhead mains are supported in various parts of the town by 33 wood, and one iron, poles, and consist of about 5,000 yards of copper wire, and there are 19 meters on customers' premises. The property was knocked down to a bid of £1,375 to Mr. Scott, of Bury St. Edmunds, who was acting on behalf of Burrell's Engineering Company, Limited.

Torquay.—It is stated that for the post of chief electrical engineer no less than 66 applications have been received.

Ventnor.—The *London Gazette* for August 24th contains a copy of the notice of application to be made to the Board of Trade for approval of the transfer of the Council's Electric Lighting Order of 1897 to the Ventnor Electric Light and Power Company, Limited.

Watford.—The District Council have resolved to retain and execute without delay the powers conferred upon them by the provisional order. The electric lighting works are to be constructed at the sewage farm adjoining the sewerage pumping station, and the design for the shaft at the sewage works is to be amended, so as to make the same available also for the purpose of the electric lighting works. Mr. Hawtayne has been instructed to prepare the necessary specifications and plans for the scheme numbered 1 in his report of October 1st, 1896, on site A, and also to prepare an estimate of the expense of carrying out his scheme.

West Hartlepool.—The Electric Lighting Committee have practically completed their negotiations with the North-Eastern Railway Company for the purchase of a site for the plant necessary for the electric illumination of a large portion of the town, and for the erection of a refuse destructor.

Windsor and Eton.—The Windsor and Eton Electric Installation Company last week commenced laying their cables from the central station, along the King's Road, as far as "Castle Mead," orders for installation and electric light supply in that neighbourhood having been received. Cables are also being laid in St. Leonard's Road.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Behr Lightning Express.—A Belgian paper says that this railway at Tervueren is running now successfully. On Thursday last week Count Adrien d'Oultremont, Commissioner-General of the Government, and his family, had a very successful run. The speed at one time, on the most difficult parts of the line, on a very steep curve and a very bad embankment, was, according to Count d'Oultremont's timing, over 120 kilometres an hour.

Dublin.—The patience of the people of Kingstown is amazing. But it is doubtful, says the *Freeman's Journal*, if it has not been carried beyond the limit of a virtue. When the electric tramway was allowed to work its own sweet will on the streets of the town, the pathways were practically destroyed. On the one hand, the roadway was raised so high that it was flush with the pathway. On the other side it was sunk so low that the kerbstone was a miniature precipice.

Dundee.—The Town Council, on 23rd inst., discussed the advisability of municipalising the tramway system. A resolution was passed approving of the principle, and a Committee was appointed to prepare and submit a draft agreement with the Tramway Company.

Highgate Cable Tramway.—The Board of Trade has granted a license for three years from the present month for the working of the Highgate Hill Steep-Grade Cable Tramway. The cars, after remaining idle for four years, were re-started a few months ago; the tramway, after being repaired, being worked under a provisional license from the Board of Trade.

Leeds.—A deputation from the Manchester City Corporation, including the Lord Mayor, visited Leeds on 23rd inst. for the purpose of inspecting the electrical tramways department of the Corporation. Accompanied by the chairman (Mr. Hannan) and other members of the tramways sub-committee, the visitors were conveyed in two cars to Kirkstall, and subsequently they travelled over the whole length of the electrical section to Roundhay Park. After dinner at the Queen's Hotel the car sheds in Kirkstall Road and the generating station at Crown Point were visited.

Sydney (N.S.W.)—The necessary work preliminary to the construction of the George Street electric tramway is slowly proceeding. Last month six tenders were opened by the Tender Board for the manufacture, supply, and delivery of steam boilers for the power house. The lowest was that of Messrs. G. and C. Hoskins, at £4,718.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cayenne-Pinheiro (Brazil)	July 22nd, 1897 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Zanzibar-Mombassa	July 13th, 1897 ...	...
Cyprus-Latakia	July 23rd, 1897 ...	...
Aden-Zanzibar	July 28th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Mazol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Siberian landlines—		
Tschita-Kaidalowo (all lines).	Aug. 9th, 1897 ...	...
Direct communication between Roumania and Servia.	Aug. 20th, 1897 ...	Aug. 24th, 1897.

April 19th, 1897.—During war between Turkey and Greece, cable between Trieste and Corfu cannot be used for messages for Turkey; they must be sent *vid* Bosnia, Montenegro and Servia.

The Ottoman Government announces that messages in secret language may not be sent to the Greek Minister and Consul in Turkey. They are to be sent in plain language.

April 21st, 1897. — The Greek Administration prohibits secret language for private telegrams for Greece.

April 25th, 1897.—The Hellenic Administration notifies delay on press messages emanating from Greek provinces by reason of the lines being blocked.

April 26th, 1897.—The Ottoman Administration notifies that, until further notice, private telegrams for Crete must be written only in plain Turkish or French language.

August 5th.—Eastern Company announce owing to interruption of East Coast route, messages for South Africa are subject to serious delay.

August 7th.—Communication with South and East Africa temporarily interrupted by both routes.

August 10th.—Eastern Company announce that traffic for South and East Africa is still subject to serious delay.

Coast Communication.—The Royal Commission on electrical communication with lighthouses and light-vessels will reassemble early in October, says the *Manchester Guardian*, for the purpose of receiving a report on the recent experiments, which the Commissioners hope will enable them to proceed forthwith with the consideration of their final report. An interim report issued in May last showed that although the lighthouse cables laid on the recommendation of the Commission had worked satisfactorily, the cables to light-vessels did not answer so well as had been expected. It was added, however, that experiments were being made which the Commissioners hoped would solve the difficulty. Unfortunately this expectation was not realised, and arrangements had to be made for a series of further experiments in order to test the efficacy of alternative schemes. These experiments have been carried out under conditions of the most favourable character, and the result will be awaited with interest.

Glasgow Telephone System.—Sheriff Jameson, Perth, has been appointed by the Treasury to conduct an inquiry into the efficiency and the cost of the working of the telephone, on September 23rd. The inquiry is also to cover the report which was laid before the Postmaster-General for the municipal telephone system in Glasgow. The inquiry is expected to last some days.

Hawaii.—The *New York Herald's* special correspondent at Honolulu, in a despatch sent *vid* San Francisco, says (according to the *St. James's Gazette*) that the French Government is showing marked concern over the possible course of the United States in reference to the landing of a cable on Neckar Island, in case, through annexation, the island becomes American territory. France is wondering whether the States, after refusing permission for a French cable on the Cape Cod coast, will encourage a British company in the Pacific. Even if England's claim to Palmyra goes back to 1889, Hawaii can produce a better title, as official records show the formal occupation of Palmyra by Hawaii to have occurred on April 15th, 1862. The question is now the subject of litigation in the courts between private parties who claim the ownership. The officers of her Majesty's ship *Penguin* are sceptical as to early connection being established between Vancouver and Australia. The vessel has left for Fanning Island to continue her cable survey. The officers say that the former surveys are valueless, as many were incorrect.

If London were like Berne.—A Dalziel telegram from Bale says that a decision has been given there by a local court which is of interest to users of the telephone. A man named Siegfried called up the central telephone office at Berne, and in some way a quarrel arose between himself and the operator. Siegfried lost his temper, and used a rather violent expression. The operator reported him, and the court to-day sentenced him to five days' imprisonment in the city gaol for using language "which is prohibited over telephone wires." The National Company has not issued any detailed instructions as to what may, or may not, be said on its lines in this country. We are afraid if Berne law were applicable in London, few users of the line would be outside the House of Detention for many weeks together. We recommend this little incident to the venerable chairman of the National Company. He might find it useful at the next meeting, when he dwells upon the patience of "our ladies."

Pacific Cable.—In a recent memorandum to the Earl of Aberdeen (Governor-General of Canada), Mr. Joseph Chamberlain is reported to have made the following remarks in his conference with the Colonial Premiers in respect to the proposed Pacific Cable:—

"The next point to which I will allude very briefly in connection with our commercial relations is the question of improved communications. That was the subject of very important resolutions at the time of the conference at Ottawa, and already I am happly to think that considerable effect has been given to those resolutions in regard to the fast mail service, which was the first and probably the most important of those resolutions. Arrangements are now in progress by which it will be accomplished, and I hope that in connection with that the service between Canada and Australia will also be improved, and there will be nothing further to be desired. There is, however, still pending the question of a Pacific cable passing entirely through British territory. Upon that we desire to have the opinions of the gentlemen present as to how far they are prepared to go. I would say in regard to this, and also in regard to the fast steam service, in dealing with the matter at all, we are giving the most striking proof we can of our good will and of our desire to meet your wishes. Neither of these proposals would have been made by us. I must frankly say that we are not dissatisfied with the present arrangements; we do not feel, although we think they are valuable proposals, yet we do not feel that they are urgent, and therefore we should not ourselves, or by ourselves, have been disposed to offer subsidies either to the steamboat service or to the Pacific cable, and we are only induced to do it by our desire to show that in any matter in which our colonies are themselves deeply interested, they may count upon the support and assistance of the mother country. Well, in regard to the Pacific cable, the matter stands thus. A representative committee was appointed, which has discussed the whole subject; it has come to the conclusion that such a cable is practicable, has roughly estimated the cost (which is probably less than was originally anticipated), and has also estimated the probable returns. What remains, however, to be inquired into is as to the subsidies which the several colonies are prepared to give towards this undertaking. Without in this venturing to pledge my colleagues, I say that to any proposal which may be made by the colonies, the Government will give their most favourable consideration.

Telephone Trunk Lines.—The Postmaster-General has notified the Mayor of Waterford that the Lords Commissioners of the Treasury have now sanctioned the provision of a trunk circuit from Dublin to Waterford, passing through Wicklow, Arklow and Wexford.

Telephonic Communication in Italy.—Work has just been commenced on the erection of an inter-urban telephone line between Milan nnd Novara. The line will be about 50 kilometres long.

The New Mutual Telephone Company.—The *Manchester Guardian* learns that the number of promises to take telephones in this company has now reached 2,000, this being the number considered necessary for commencing a remunerative telephone exchange for Manchester and the district. The syndicate and committee have been working in accordance with the terms of the Treasury minute dated May 23rd, 1892, in which it is stated, as a matter of general policy, that competition "will not be excluded" in the telephony of the United Kingdom. There are, however, laid down certain conditions with a view of preventing companies being formed "whose sole object it is to force the existing licensees to buy them up," and the energies of the syndicate and general committee have up till the present moment been concentrated in the endeavour to bring about a compliance with these conditions. The first step was to find gentlemen to provide the money necessary for organising a sufficient amount of support to ensure the financial success of the undertaking. Both, our contemporary is informed, have been accomplished. The second step was to obtain formal votes in favour of the new company by the municipal authorities. This has also been effected, resolutions in favour of the company having been passed by the Corporations of Manchester, Salford and Eccles, and the Stretford District Council. With regard to the capital required, it is estimated that £100,000 will be ample to provide a telephone exchange capable of supplying upwards of 5,000 subscribers, and leaving a margin of unused wires along the lines for future development. With a view of getting the telephone users to be, as far as possible, the proprietors of the company, it is arranged that anyone holding £25 in shares in the company shall be entitled to a reduction in the price of the telephone of 15s., whilst holders of £50 in shares will obtain a reduction of 25s. in the annual charge. The latter is equal to 2½ per cent. on the amount invested, which would then stand to earn the ordinary dividends of the company. If each of the 2,000 applicants for telephones in the new company would invest £50 in shares, the whole capital necessary for producing an exchange of upwards of 5,000 would be provided; but as this is hardly to be expected, it will be necessary for many to take a larger number. The charge per telephone is fixed at £6 10s., but an annual reduction on this price will be made to persons who apply before the registration of the company.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—The Town Urban District Council require tenders for electric lighting.

Derby.—August 30th. The Corporation want tenders for the supply of one alternating current dynamo and engine, also a continuous current dynamo for the present engine. Electrical engineer, Mr. J. E. Stewart.

France.—September 7th. The French Post and Telegraph Authorities are inviting tenders for the supply of 40 tons of homogeneous iron wire, 2½ mm. in diameter, 80 tons of ordinary iron wire 7 mm. in diameter, 10 kilometres run of iron pipes 65 mm. diameter for pneumatic lines of 200 kilometres of submarine telegraph cable. Tenders to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Hull.—November 5th. The Corporation invite tenders for the electrical equiqment of their tramways, to the extent of about 9 miles double track and ½ mile single track. The contract will not be divided and will include engines and generators, switchboards, feeders, poles, brackets, trolley wire, rail bonding and all accessories, also the first instalment of cars (15 motor cars and 5 trailers). Further information can be obtained from our "Official Notices." City engineer, Mr. A. E. White. City electrical engineer, Mr. A. S. Barnard.

Llandudno.—September 22nd. The District Council wants tenders for certain works in connection with the electric light and dust destructor scheme, including the supply of water tube boilers, condensing plant, &c., steam engines and dynamos, switchboard, battery, travelling crane, underground mains, arc lamps, posts &c. Particulars from Mr. A. H. Preece, 39, Victoria Street, Westminster. See our "Official Notices."

Ludlow.—September 1st. The Corporation of Ludlow offers a prize of £20 for the best and most economical scheme of electric lighting for the borough. Town Clerk, Mr. John Herbert Williams. Should the Corporation employ the engineer whose scheme is awarded the prize to carry the work out, then the £20 will merge in commission.

Port Elizabeth.—September 21st. The Town Council invite tenders for lighting the streets and municipal buildings of Port Elizabeth by electricity in consideration of the grant of a concession for the exclusive right of supplying electric current through the streets and roads of the town to private houses, stores, &c., for terms of 5, 15, 20, 25 or 30 years respectively.

Roumania.—November 15th. Tenders are being invited by the Municipal Authorities of Ploesti, for the concession for the establishment and working of an electricity generating station in the town, during a period of 40 years for private and public lighting and also for power transmission purposes.

Russia.—November 1st. The Municipal Authorities of Novorossisk, South Russia, are inviting tenders for the concession for the construction and working of an electric tramway and for the electric lighting of the town.

Sofia.—September 22nd. The Secretary of State for Foreign Affairs has received a despatch from the Acting British Consul-General at Sofia, stating that the municipality of that town invite tenders for—(1) The supply of electric current to light the streets as well as public and private buildings in the town and the supply of electric power; and (2) The construction and working of electric tramways in the town and suburbs. Tenders will be received at the offices of the municipality of Sofia. Such further particulars as have been received may be seen at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Switzerland. — September 25th. Tenders are being invited by the Municipal Authorities of Lausanne for the concession for the establishment and working of a central electricity supply station in the town. Tenders to be sent to, and particulars may be obtained from, Le Conseil Municipal de Lausanne.

West Ham.—September 20th. The Council wants tenders for the wiring for electric lighting of the Technical Institute and Public Library at Romford Road, Stratford, E. See our "Official Notices" for further particulars.

Whittingham, (Lancs.).—September 20th. Tenders are invited for electric lighting and plant required at the new hospital and reception wards at the County Asylum, Whittingham, for the Lancashire Asylums Board. Particulars at the offices of Messrs. Simpson and Duckworth, architects, Richmond Chambers, Blackburn, or at the offices of the consulting engineers, Messrs. Fawcus and Clirehugh, Temple Chambers, Brazennose Street, Manchester.

CLOSED.

Brighton.—The Town Council have accepted the tender of the Blake & Knowles Steam Pump Works, Limited, of London, E.C., for the erection of surface condensers, pumps, and cooling towers with pipe connection for the electricity generating station, the quotation being £4,930. Messrs. W. R. Renshaw & Company, of Stoke-on-Trent quoted £4,695, and Wright's Patent Heater Condenser Company, £6,945.

Halifax.—The *Contract Journal* says that the following are the tenders accepted for work in connection with the electric tramway works for the Town Council:—Electric Construction Company, Limited, electrical equipment of tramway cars, £4,171 10s., trolley wire, insulators, rail bonds, &c., and fixing, £984 7s., tramway generators and fixing, £1,800; J. Spencer, Wednesbury, trolley poles, £1,090 10s.; Chloride Electrical Storage Syndicate, Limited, two batteries of accumulators, £3,070; Callender's Cable and Construction Company, Limited, cable, £1,237 5s.

Liverpool.—The Lighting Committee has accepted the tender of Messrs. Holme & Green for the completion of the Paradise Street electrical station at £5,605.

Sunderland.—The contract for high and low tension cable extensions for Sunderland has been secured by the Fowler-Waring Cables Company, Limited, North Woolwich.

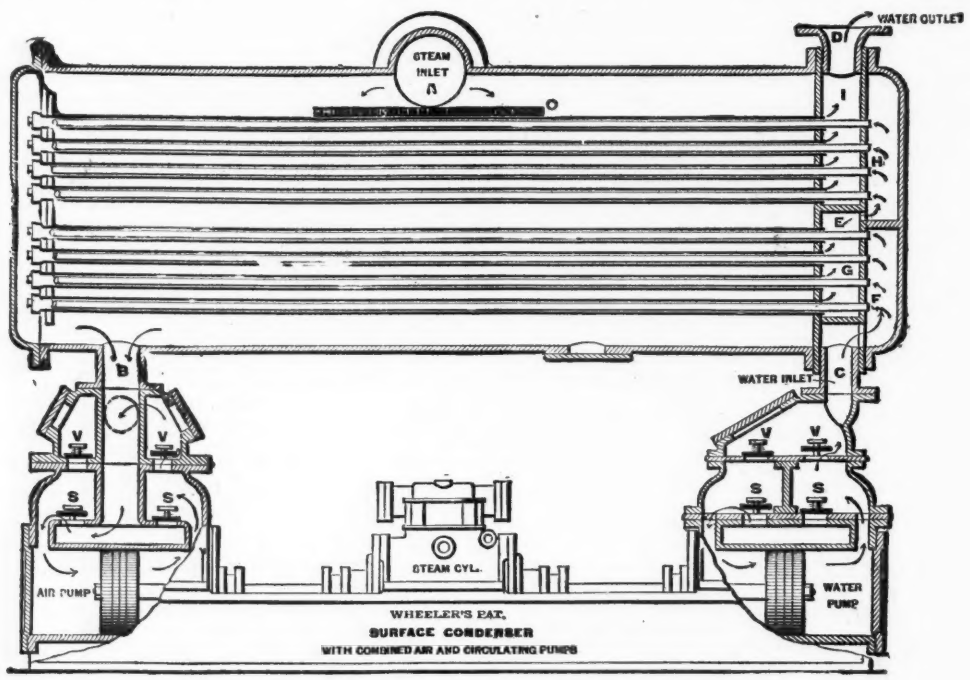
NOTES.

Personal.—Mr. G. A. Abbott has been appointed secretary to the Rochester, Chatham and District Electric Lighting Company.

It is stated that Mr. Harold W. Couzens has resigned the position of electrical engineer to the Taunton Town Council, having secured a position with a firm of consulting electrical engineers in London.

Post Office Anomalies.—Our contemporary, the *Automotor and Horseless Vehicle Journal*, seems to have gone a little out of its legitimate line in writing on the above subject. Like many other journals, the paper in question assumes that because nothing is said therefore nothing is done; in other words, that because the scientific exploits of the engineering branch of the Post Office are not blazoned abroad, that therefore they do not exist. It would probably be an eye-opener to our contemporary if it were allowed to inspect the records of work done in the engineering branch of the Post Office. No doubt it is perfectly true that "one sees but little evidence of acquaintance with the latest advances in telegraphy," but with some people only seeing is believing. We have before pointed out that the Post Office is not a public laboratory, whose chief function is to carry on original research; it has quite enough, we expect, to do in developing and improving existing forms of apparatus, and in keeping these up to modern requirements. Those whose ideas of telegraphy consist in the notion that a telegraph is simply a wire on a number of poles worked by a single current key and a Morse sounder, may be excused if they think the work being done by the Post Office engineering officials is of a trivial nature; but no doubt the officials will manage to survive the contempt with which they are looked upon.

The Wheeler Condenser.—The accompanying cut gives a sectional view of the Wheeler condenser, which is rapidly gaining favour in the eyes of central station engineers in America. The condensing water is passed through a double



set of tubes, so arranged that they are free to expand and contract without the use of packing; the inner and outer tubes being secured to their respective heads by screw threads on the enlarged ends. This condenser is used in the power houses of the Brooklyn Heights Railroad Company, as was briefly mentioned in our article last week.

Exhibition of Motor Cars.—At the Laundry Exhibition now being held at the Agricultural Hall by Messrs. Cordingley, there are a number of horseless carriages and vans shown by some of the leading makers, including three cabs belonging to the Electric Cab Company, which are advertised to be let by the day, week, or month.

Appointment Vacant.—A demonstrator is required for the Electrical Engineering Department of the Municipal Technical School at Manchester. See our "Official Notices."

The Unreasonableness of some Specifications.—It has been often pointed out in these columns that clauses in many municipal specifications are of an extraordinary nature, and likely to impose most unfair conditions upon contractors. Nor does there seem to be much disposition on the part of many municipal authorities to delete the objectionable clauses from their contracts. Perhaps one of the most insulting conditions that contractors have occasionally to swallow in electrical work is one which stipulates that a certain standard of wages shall be paid to the men who are engaged on the contract. We believe that such a clause had its origin in an excess of virtue on the part of the London County Council, some of the members of which having an intimate acquaintance with the East End sweating system, were resolved that it should not be repeated on any County Council contracts. But apart from the fact that electrical contractors are not sweaters by nature, it is impossible in the engineering, and indeed in most recognised trades, to do otherwise than pay a fair wage. Skilled men can always demand and obtain ample recompense for their work, and it savours too much of impertinent interference to suggest what a contractor shall pay his workpeople. We have been led to make the foregoing remarks after perusing an electric lighting specification for a municipality in the Midlands. Nor is this the only clause that will irritate contractors; there are others relating to verbal instructions, power to suspend work without compensation, maintenance (a specially vexing feature being here introduced) and arbitration, clauses which are open to most serious objection. Fortunately in this instance the borough electrical engineer is well known for his fairness and ability, and we think most contractors would be inclined to carry out the work plus objectionable clauses, but the danger is that these tyrannous conditions might be insisted upon by other persons than the engineers. A careful consideration of the worst clauses of this specification lead us to think that the mind of the lawyer has been occupied in evolving them, and it is impossible for the layman to appreciate all the niceties of the legalised mind. We sincerely believe that no borough electrical engineer would insist upon the impossible clauses of this Midland specification, as there would be always a distinct danger in undertaking work under it. The necessity for some combined action in resisting the introduction into contracts of impracticable clauses is very apparent, but it is important that such common action should be taken by the contractors in conjunction with the municipal electrical engineers. If representatives of the principal contractors were to meet the accredited officials of the Municipal Electrical Association, a speedy solution of the matter would be arrived at.

The Engineer's Strike.—Messrs. Paterson & Cooper, electrical engineers, are stated to have granted the eight hours' concession to their employés. Messrs. Brunner, Mond, and Co., chemical manufacturers, Silvertown, are also stated to have conceded the eight hours' day.

It is reported in the daily press that on Saturday last a disturbance occurred at the works of Messrs. S. Z. de Ferranti, Limited, at Oldham, in consequence of the introduction of non-union labour.

The position of affairs at Messrs. Crompton's works is stated in the following paragraph in yesterday's *Times* :—

> At a meeting on Wednesday of the joint committee of the allied trades, held at the headquarters, Nelson Square, Blackfriars, to consider the situation in the engineering dispute, Mr. David Brown (secretary) reported that a remarkable state of affairs existed at the works of Messrs. Crompton & Co., electrical engineers, Chelmsford, where men who had elected to remain at work were not allowed under any pretext whatever to leave the factory. All applications from the workmen to leave the premises were refused, and it was impossible to get out owing to the gates being always locked and the walls too high to scale. Mr. James Berry, an engineer, who had come from Bolton to work at Messrs. Crompton's, attended before the committee and stated that during the five days he had been employed by the firm he had not been allowed to leave the factory. On Sunday last he applied to the watchman to let him out, as he had an important engagement to fulfil at Southend, but, in compliance with the orders of the head manager, permission was refused. Eventually, however, when it was too late to keep the appointment, he was permitted to leave the works. On Tuesday morning Berry refused to be imprisoned any longer, and gave in his notice and applied for his wages that were due. Although the agreement entered into was that notice should be given on either side to take effect immediately, the firm refused to pay his wages. It was eventually decided to place the whole circumstances of the case in the hands of the joint committee's legal advisers and to institute proceedings against the firm for unlawful imprisonment.

Telegraphists' Grievances.—A report drawn up by the delegates from the London branch attending the Postal Telegraph Clerks' Association Conference at the Compton Hotel, Liverpool, on Sunday, will be presented to the Metropolitan Executive during the week. In this particulars will be given as to the attitude of the delegates of the various provincial branches with regard to the most of them being in favour of pacific measures. One of the officials stated that the committee had not made the best use of their opportunity when they had the Department at their mercy. At the Memorial Hall meeting, when Sir Albert Rollit's pacific telegram, announcing the decision of the Postmaster-General to grant an inquiry, was read, it was, of course, too late to do anything except to agree to his suggestion. Any other course would have alienated the sympathy of the Press and the members of Parliament. Many of the men think that the responsibility rests with the people who invited Sir Albert Rollit to send his telegram. In conclusion, he said that undoubtedly the agitation would be renewed even more strenuously at a future date, when the association hopes to be both financially and numerically stronger.

A special meeting of the committee of the Postal Telegraph Clerks' Association was held at Falcon Square on Tuesday evening, Mr. E. C. Fugler, vice-chairman of the association, presiding. The chief matter for consideration was the state of the finances, and a scheme for the augmentation of the funds was discussed at considerable length. The lady members of the association complained that the Department had asked lady clerks to volunteer to do night work after 8 p.m., *i.e.*, from 2 p.m. until 10 p.m. The lady clerks have decided to fight against the suggested innovation. Mr. Garland, secretary of the association, said, in an interview last evening, that the men were thoroughly in sympathy with the female members of the staff upon the "2 to 10" question. The object of the Department was undoubtedly to increase female labour, and by so doing to gradually make the men less indispensable. Women were much easier to manage than men—at least, so far as postal disputes were concerned, and figures showed that during the past six or seven years the number of lady telegraphists taken on throughout England (exclusive of London) was relatively treble that of the men. The stipulation at present in vogue at the General Post Office is that no lady clerk shall commence work earlier than 8 a.m., nor finish later than 8 p.m., except occasionally during the summer months. Mr. Garland also states that at the conference of telegraph clerks on Sunday, the delegates were watched and "shadowed" during their brief sojourn in Liverpool.

Marriage.—Mr. H. Collings Bishop, resident electrical engineer to the Leyton Urban District Council, was last week presented with a set of silver fish carvers, as a token of respect and good wishes from the staff of the electric light station, on the occasion of his marriage.

Exhibition of Instruments for Determining the Frequency of an Alternating Current.—Messrs. George S. Moler and Frederick Bedell presented a paper on the above subject before the Detroit meeting of the American Association for the Advancement of Science, which has just been held The following is a brief abstract:—The instruments here included are two in number. The first one, which has already been described,* consists of a small synchronous motor, brought to speed by a crank handle connected with the motor by a suitable train of gears. The apparatus contains an electrically operated speed counter, so arranged, that its readings gives the exact value of the frequency of the alternating current with which the synchronous motor is supplied. The whole apparatus does not weigh over 9 lbs. The reading is correct to within ·05 of an alternation. The second instrument consists of a sonometer or monochord. The alternating current flows through a piano wire mounted upon a sounding board. The wire passes between the poles of a permanent magnet. By means of a sliding bridge the period of the wire may be made equal to that of the alternating current. This is indicated by the vibration of the wire. A scale is arranged so that the position of the bridge indicates the frequency directly.

* See "A Synchronous Motor for Determining the Frequency of an Alternating Current," by George S. Moler, *Physical Review*, March-April, 1897.

The Institution's Standard of Copper Conductivity.—Mr. Albert Campbell, writing to the *Electrician*, says that in the "Wiring Rules of the Institution of Electrical Engineers," "the standard of copper conductivity adopted is that the resistance of a copper wire weighing 100 grains, 100 inches long, should be 0·1516 ohms at 60° F. This, when put into the rational units, is equivalent to:—1 metre 1 gramme has a resistance of 0·1519 international ohms at 15° C. I think it is well that the public should know that this corresponds to Matthiessen's *hard copper* standard, and that good soft copper ought, when compared with it, to come out at about 102 per cent. conductivity. Matthiessen's *soft* copper had a resistance of about 0·1500 international ohms for 1 metre 1 gramme. This last, when the density is 8·90, is the standard given by M. Hospitalier, and is also that adopted in 1887 by the National Electric Light Association in America. It seems a pity, therefore, that the Institution of Electrical Engineers, when authorising the perpetuation of an arbitrary standard, should not have chosen the 'soft' standard, and so have avoided the absurdity of ordinary pure soft copper coming out at 102 per cent."

The French Telegraphic Administration and the Press.—We reproduce the following from yesterday's *Times*:—

"Sir,—The French Telegraphic Administration having become as unsafe as the Ottoman Post Office, I am compelled to write by the ordinary post in order to show the way in which the secrecy of telegraphic correspondence is respected in France.

"On Monday, August 16th, the journal *Le Temps*, the well-known Governmental French paper, published the following lines, in which it summarised and criticised a telegram from your Rome correspondent referring to 'The Royal duel:'—

. . . . On télégraphie de Rome au *Times* que parmi les télégrammes de félicitations ou de sympathie reçus, comme toujours en pareil cas, par le comte de Turin, on en trouve un de l'empereur d'Allemagne. Le fait n'a rien de bien surprenant ni d'exceptionnel; mais le correspondant anglais dit que ce télégramme est particulièrement "chaleureux." L'a-t-il lu? On n'en connait pas le texte; mais tout le monde peut deviner ce que le télégramme contiendrait, si l'empereur d'Allemagne en avait confié la rédaction au correspondant gallophobe du *Times* à Rome.

"Now the telegram from your Rome correspondent appeared only in your issue of Tuesday, August 17th (12 hours after it was 'quoted' in *Le Temps*); but it had passed through Paris on the 16th at an early hour.

"Not only must someone connected with the French Administration have committed the dishonest act of communicating a telegram which had not yet appeared in your columns, thus defrauding you of the *primeur* of information, for the transmission of which you had paid, but the *Temps*, as you will see, attacked your Rome correspondent for comments on the German Emperor's telegrams, comments which were never made, On the contrary, your Rome correspondent reproduced faithfully the opinions of the Italian papers, 'eulogising the impartial and dispassionate attitude generally assumed by the French Press.'

"The following is the text of the telegram in question, as published in the *Times* of the 17th, more than 12 hours after its 'quotation' by *Le Temps*:—

Rome, *August 16th.*

Neither the Italian Press nor the public are at pains to disguise their lively satisfaction at the result of yesterday's encounter. The receipt of the news was followed by spontaneous and enthusiastic demonstrations in all parts of Italy. On arriving at Turin early this morning the Count met with a cordial reception from the populace.

Telegrams of congratulation to the Royal Family and the Count of Turin have been exceedingly numerous, among them, it is stated, being two from the German Emperor. Official journals adopt a tone of complacency, saying that all's well that ends well. They make a point, however, of eulogising the impartial and dispassionate attitude generally assumed by the French Press as being calculated to preclude unfavourable political consequences arising from the incident.

"For the information of the public, I may add that such a case is not an isolated one, that it occurs continually, and that I have had to complain about it many times.

"I am, Sir, your obedient servant,

"YOUR PARIS CORRESPONDENT."

The Editor of the *Times* awaits explanations from the French Telegraphic Administration and *Le Temps*.

The Queen Pharos Automatic Arc Lamp.—Messrs. Queen & Co., an American firm, have brought out a new arc lamp specially designed for projection in the physical laboratory and lecture room, for which the following twelve points of superiority are claimed:—It keeps in focus constantly, regulates and runs silently, regulates at short intervals, the carbons separate very little, it lights up the screen evenly, maintains the same intensity, no attention required to help it regulate, does not flicker nor flash, its light power is the highest, the full crater is projected, the negative carbon is non-luminous, and the adjustments are all outside. Its mechanism is contained in a nickel-plated case about 4½ inches high, 5 inches long, 2¼ inches wide. The carbon holders and gears are placed outside on the narrow front, but the carbons are enclosed in a box with a circular window holding a glass screen to protect the lenses from sparks given off by the arc light.

CITY NOTES.

Imperial Tramways Company, Limited.

THE half-yearly meeting of this company was held in Bristol last week, Mr. George White presiding.

The CHAIRMAN, after reference to the general work of the company during the past year, dealt with the Middlesborough tramways, the concern which has occupied by far the larger part of attention during the past half-year. The directors had been busily engaged in carrying through the provisional order to authorise extensions of the line at Middlesborough so as to connect up with the towns of Stockton and Thornaby, and he had to acknowledge the company's great indebtedness to the managing director and engineer (Mr. Clifton Robinson) for the manner in which he conducted and successfully completed the negotiations with three corporations and other local authorities. They were also fortunate in being able to acquire the present Stockton Tramways, together with a valuable depot adjoining the river and railway, situated, indeed, in the exact spot which they should have chosen for an electric power station. The cost of acquiring the Stockton Tramways is exceedingly reasonable, and, including all payments to be made in connection therewith, will amount to about £12,500. For this they not only get the old tramways at Stockton, together with the engines, rolling stock, and valuable depot, but they also became possessed of the Darlington tramways, a separate undertaking which is now being worked at a small profit, and could, he thought, be made to yield a fair return upon any money put into it. The acquisition of the powers to connect up the towns of Middlesbrough, Thornaby, and Stockton by one continuous system of electric tramways was of great value. They intended that the Imperial Tramways Company should carry out the construction works without the intervention of contractors, and therefore at the minimum outlay necessary. So satisfied was his firm that the Imperial Tramways Company had a most valuable property in the new Middlesbrough, Thornaby and Stockton Electric Tramways, that they had no hesitation in coming to an arrangement by which they made themselves responsible for the raising of the whole of the capital necessary, so as not to have to await the result of any appeal either to the shareholders or to the general public. From estimates made the whole work, including the capital already spent on the Middlesbrough undertaking, and the amount paid for the Stockton and Darlington lines, will be carried out for somewhere between £200,000 and £250,000, whilst it would interest them to know that the most moderate estimates of traffic made show an ample margin of profit to give a very good return upon the outlay, such a return, indeed, as to materially assist in the expansion of the present 6 per cent. dividend being paid on Imperial shares. They had not yet quite settled the exact programme and the manner in which the capital would be issued. The carrying through of this important electrical undertaking at Middlesbrough, Thornaby and Stockton will require constant watchfulness at the hands of the directors, and he would be much surprised if the result did not add materially to the stability of the Imperial Tramways Company.

The report was adopted.

Stock Exchange Notice.—The Committee has appointed Wednesday, September 1st, a special settling day in House to House Electric Supply Company 10,000 7 per cent. cumulative preference shares, Nos. 58,001 to 68,000. The same securities will also be quoted in the official list.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending August 22nd, 1897, were £1,021; week ending August 23rd, 1896, £969; increase, £52; total receipts for half-year, 1897, £7,314; corresponding period, 1896, £7,498; decrease, £184.

The Cuba Submarine Telegraph Company. The traffic receipts for the month of May are £3,849, as compared with £5,484 in the corresponding month of last year.

The Liverpool Overhead Railway Company. The receipts for the week ending August 22nd, 1897, amounted to £1,518; corresponding week last year, £1,363; increase, £155.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 20th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,758.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Aug. 18th.	Closing Quotation, Aug. 25th.	Business done during week ended Aug. 25th, 1897. Highest.	Lowest.
149,900£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5 — 6	5 — 6	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	54 — 57 xd	54 — 57	56½	...
3,038,020£	Do. do. 5 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	101 —102	101 — 102	101½	101½
3,038,920£	Do. do. Defd.	Stock	...	...	...	10½— 11	10½— 11	...	...
130,000	Brasilian Submarine Teleg., Ltd.	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15⅛
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3¼— 3⅜xd	3¼— 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	170 —175	180 —185	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	106 —107	106 —107	107	106⅞
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	⅞— 1	⅞— 1	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	9 — 10	9 — 10	9 5/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9½ — 10½	9½ — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	4½%	103 —106 %	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	9½ — 10	9½ — 10	9⅛	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	16¾ — 17¼	16¾ — 17¼	17	16 13/16
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	17½ — 18½	17½ — 18½	...	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 —104 xd	101 —104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	128 —131	129 —132	130½	130
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7%	17½— 18	17½ — 18	17⅝	17⅝
35,500£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	99 —103	99 —103	...	...
133,100£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5%	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	128 —131 xd	128 —131	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	99 —103	99 —103	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	103 —105xd	103 —106	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	107 —110 %	107 —110%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½— 12	11½— 12	...	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	16⅝— 17½	16⅝ — 17½	17	16⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	10 %	10%	26½ — 27½	26½ — 27½	27	26⅝
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	54 — 57	54 — 57	...	...
100,000£	London Platino-Brasilian Teleg., Ltd. 5 % Debs.	100	6 %	6 %	6%	107 —110	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2¼	2 — 2¼	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6¼ — 6½	6⅝ — 6⅝	6½	6 7/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6¼	6 5/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —110	105 —110	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4¼%	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 —110	...	...
11,839	Reuter's Ltd.	8	nil	5 %	5 %	7 — 8	7 — 8	7½	7¼
3,381	Submarine Cables Trust	Cert.	...	...	...	135 —140	135 —140	...	...
58,000	United River Plate Teleph., Ltd	5	3 %	4 %	...	3½— 4⅜	3½— 4	3 3/16	3⅜
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	100 —105	...	...
15,609	West African Teleg., Ltd., 7,501 to 22,109	10	nil	4 %	nil	5 — 6	5 — 6	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 — 107	104 —107	106½	...
64,256	Western and Brasilian Teleg., Ltd.	10	3 %	3 %	2 %	9 — 9½	9 — 9½	9¼	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6⅝— 7¼	6⅝— 7¼	...	...
33,129	Do. do. do. Def. Ord ...	7½	1 %	1 %	...	2¼— 2⅝	2¼— 2⅝	...	...
382,230	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	102½	102
88,321	West India and Panama Teleg., Ltd.	10	½%	½%	1 %	⅞— 1⅛	⅞— 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 10½	10 — 10½	10½	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½— 9½	8 — 9	8	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	105 —108	105 —108	107½	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7%	106 —110	106 —110	...	...
160,100£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6%	102 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply ...	5	4½%	5 %	6 %	12½— 13½	12½— 13½	12⅝	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6¼	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	9⅜— 10⅛	9⅜— 10⅛	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	4½%	110—113	110 —113	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	23½— 24½	23½— 24½	23 13/16	23⅜
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16½— 17½	17⅛	16 15/16
400,000	Do 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	130 —135	130 —135	132½	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	nil	nil	12⅜— 13½	12⅜— 13½	...	...
20,000	Do do. do. 6% Pref., 40.001— 60,000 ...	10	...	6 %	6 %	15 — 15½xd	15⅛— 15½	15⅜	15 5/16
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...		9 — 9½	9⅛— 9½	9 7/16	9⅜
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	5 %	16½— 17½	16½— 17⅛	17½	...
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem. ...	10	...	...	...	16 — 17	16 — 17	16½	...
220,000	Do 4½% first mortgage debenture stock	...	4½%	4½%	4½%	118 —122	118 —122	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	15 — 16	15 — 16	15⅜	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	17 — 18	17 — 18	17⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11 xd	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
67,900	Westminster Electric Supply Corp., Ord. 101 to 68,000 ...	5	5 %	7 %	9 %	14½— 15½xd	14½— 15½	15¼	14⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
‖ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation Aug. 18th.	Closing Quotation, August 25th.	Business done during week ended Aug. 25th, 1897. Highest.	Lowest.
20,000	British Electric Traction	10	...	...	...	13¼— 13⅜	13¼— 13⅜	13⅜	13 7/16
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	3	2½%	...	...	⅞— 1⅛	1 — 1⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1¼— 1½	1¼— 1½	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	...	...	105 —109	105 —109	107½	107
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	93 — 97	93 — 97	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10	...
143,106	Do. do. do. £6 paid	10	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1½— 1⅝	1½— 1⅝	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
630,000£	City and South London Railway	Stock	1⅛%	1 1/16%	1 1/16%	65 — 67	65 — 67	66¼	65½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1½— 2	1½— 2	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	2¼— 2⅜xd	2¼— 2⅜	2⅜	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	4¼— 4⅜	4 — 4½	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	5½%	1⅜— 2	1⅜— 2	1⅞	...
16,343	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	2⅞	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅜— 1	⅝— ⅞	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	½— ⅝	½— ⅝	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	18½— 19½	18½— 19½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	108 —113	109 —114	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	20½— 21½	20½— 21½	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅞%	2⅞%	11⅞— 12 xd	11⅞— 12 xd	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅝— 16¼xd	16¼— 16⅜xd	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	37 — 40	37 — 40	39	38½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £8 paid ...	10	...	...	...	10⅝— 11¼	10⅝— 11¼	11¼	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9½.

Electric Construction Corporation, 6 % Debentures, 104—106.

House-to-House Company, 7 % Preference, of £5, 10½—11.

Do. do. 4½% Debentures of £100, 108—110.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 13¼—13⅜; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 1⅜—2.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

Bank rate of discount, 2 per cent. (May 13th, 1897).

REVIEWS.

The Law of Motor Cars, Hackney and other Carriages: An Epitome of the Law, Statutes and Regulations. By G. A. Bonner, B.A., Barrister-at-Law. London: Stevens and Sons, Ltd., 119, Chancery Lane.

This book gives in a concise form the law relative to all matters concerning the use of locomotives, carriages, and other vehicles upon highways. The first chapter is devoted to the Locomotives on Highways Act, 1896, under which act motor cars come. The bringing together of the principal statutes relating to every class of vehicle into the appendix of one volume, will doubtless prove a great convenience to those interested in the subject.

Graphic Methods of Engine Design. By Arthur H. Barker. 3s. 6d. Manchester: The Technical Publishing Company.

The object of the author is to present the student with a series of easy constructions for use in the drawing office on the one hand, and on the other to show the connection between the science of engineering and theoretical mechanics.

Our author premises that though there is no doubt value in a mathematical and scientific training to an engineer, yet the actual amount of knowledge of these subjects necessary for even a first-class designer is really very small. And there can be little doubt that such is really the case, at least so far as regards the design of steam engines and machinery. Considerable knowledge of mathematics is very necessary in working out many original departures in, let us say, bridge work, but when records have been established the perpetuation of a type becomes one of the simplest of matters, and any skill there may be consists largely in scheming out calculated stress and merchant sizes of material so as to avoid an undue redundancy of material. But in machine design the question of dimensions becomes often entirely one of minimum thickness of casting to avoid chill or simply of appearance, and our author rigidly observes that nothing but practical experience will enable a designer to do his work properly, making a design that will not merely serve the ultimate purpose, but one which can be made conveniently. We all know the design that cannot be cast readily, or the expensive forging. So much depends on appearance, that design is largely a matter of artistic feeling, but, like every block of marble which contains a statue, so every machine, no matter what its outward form and dimensions must contain a machine of sufficient parts and strength. To be able to design this inner skeleton is but one part of design, the other part of design is to put on the flesh.

We fear the author has not had a happy experience of engine attendants for he says, when referring to the risk of re-admission of steam in a badly designed Meyer valve gear, that if it is possible to work an engine wrongly the attendant will find it out and do it as much as possible. We should rather call this book one on engine designing, omitting the graphic title for it by no means is a book of graphic design. There is as much of ordinary calculation intermingled with a few diagrams whose duty seems rather to be to give colour to the title than to be of much value to the designer. At the same time we would by no means condemn the book because it does not follow up strict lines. The author knows something of what he writes, and though he perhaps goes into greater detail and complication than the man in actual practice finds necessary, there can be no harm in the student for whom this book is largely intended, being thoroughly versed in full methods, leaving it to his more mature knowledge to eliminate redundancies as he finds himself able so to do.

Physics for Students of Medicine. By A. Daniell, M.A., D.Sc., &c. London: Macmillan & Co., Ltd.

The author of this book is examiner in physics to the Royal College of Physicians of Edinburgh. He has arranged the matter so that the subjects which most closely concern those for whom the book is written, are treated in greater detail than those which are of less direct utility. This arrangement is however barely noticeable, so that the book is to all intents and purposes one which might equally appeal to all interested in the subject of physics. There is rather a tendency in the book to deal with too many subjects, with the result that the explanations given are barely sufficient to make the point considered comprehensible, at least to the average student.

First Stage Sound, Light, and Heat. By John Don, M.A., B.Sc. London: W. B. Clive, University Correspondence College Press, 13, Bookseller's Row, Strand, W.C.

This is a well arranged book which, if it possesses no striking points of novelty, is, at least, a work upon which a student may safely rely. It was prepared to meet the requirements of the elementary stage of sound, light, and heat of the Science and Art Department. The solutions of the exercises in heat are arithmetical entirely, a point of distinct advantage in enabling a student to follow the reasoning.

The Tutorial Trigonometry. By William Briggs and G. H. Bryan. London: W. B. Clive, University Correspondence College Press, 13, Bookseller's Row, Strand, W.C.

There is probably more difficulty in producing an original book on trigonometry than on any other allied subject. At the most, a writer can but rearrange the order of the matter, and explain in a more colloquial style than old authors would have considered decent. There is a smack of good old Todhunter about Messrs. Briggs and Bryan's work which, if it takes away from its originality, at least makes the book a sound one. The exercises given appear to be carefully chosen.

Euclid: Books I.—IV. By Rupert Deakin, M.A. London: University Correspondence Press, 13, Bookseller's Row, Strand, W.C.

We can recommend this book as an excellent one for students. At the end of each proposition the author gives some well compiled notes which must materially help the learner. The selection of exercises is also very satisfactory. A section has been written telling the student how to set about the solution of any given rider. The use of heavy type and heavy lines in the diagrams is a very material help.

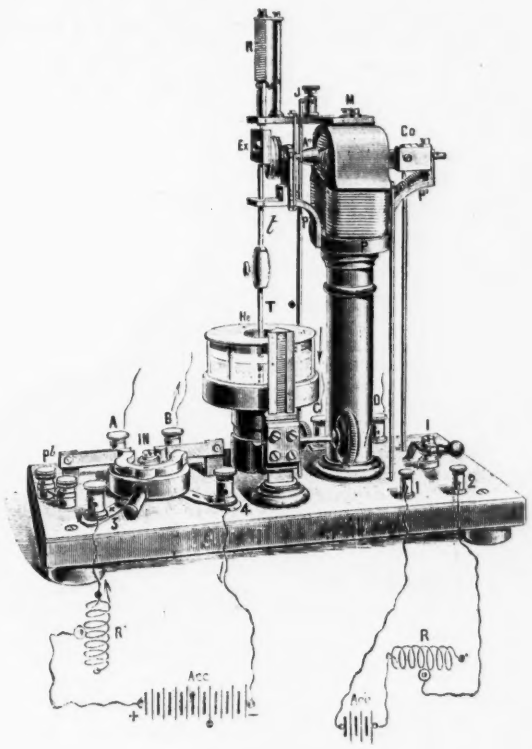
THE ACADÉMIE DES SCIENCES.

Mercury Interrupter for Powerful Rhumkorff Coils. Note by Messrs. Ducretet and Lejeune, presented by M. A. Cornu.

Neef's interrupter with a vibrating plate cannot be used with powerful Ruhmkorff coils, the sparks that flash in the air at the point where contact is periodically established and broken produce sufficient heat to bring about the rapid deterioration of the metallic surfaces and prevent the regular action of the coil. The Foucault interrupter is suitable for the production of the periodic interruption of the current in the primary circuit of powerful bobbins, but it is slow; moreover, the oblique movements of the interrupting rod in the mercury, the form and dimensions generally given to the cup for the mercury and the alcohol cause these two liquids to be spilt all around the cup splashing every part and frequently leading to the ignition of the alcohol. These bad conditions of working prevent the Foucault interrupter from being used for experiments of long duration, and it is impossible to obtain from it the variations of speed required for radiographic and fluoroscopic operations.

The model that we have designed, which is shown in the accompanying figure, obviates all these defects; it was suggested by those described by Gordon and Londe.

The form of the cup Hg, narrow at the lower part which receives the mercury prevents lateral movements of the mercury, the wide part, which is of a suitable height, receives the alcohol. Under these conditions the liquids are no longer spilt out of the cup, and the alcohol is not ignited. The arrangements of the interrupting rod conduces to this most satisfactory result. This rod, *t*, T, has a perfectly rectilineal alternating movement, without any eccentric mass; it has no lateral movement to agitate the mercury, which would have a bad effect. It is balanced, by this arrangement it is possible



to give it very great speed which can be varied between very wide limits by the action of a rheostat if the movement is imparted by a little electromotor, M, according to the figure.

The cup, Hg, with its rack attachment, can easily be regulated according to the purpose for which it is required during the working of the trembler and the coil. A reverser IN completes this independent interrupter. Pb is a fusible lead required when accumulators are used.

THE PREDETERMINATION OF THE REGULATION OF A TRANSFORMER WITH NON-INDUCTIVE LOAD.*

By FREDERICK BEDELL, Ph.D., R. E CHANDLER, M.M.E., and R. H. SHERWOOD, M.E.

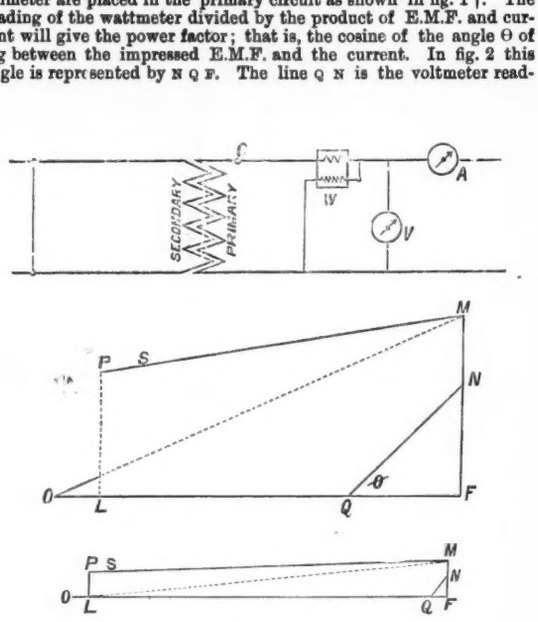
In this paper it is proposed to give a method for determining the exact regulation of a transformer without the necessity of applying a load. A corresponding method for obtaining the efficiency of a transformer without loading is in common use;† an accurate method for finding the regulation will, it is thought, be of equal service.

* Presented at the Detroit meeting of the American Association for the Advancement of Science, August, 1897. We are indebted to the Authors for advance proofs.

† In this method the transformer is tested by placing a wattmeter in the primary circuit; the secondary (low potential coil) is short-circuited through an ammeter, and the primary pressure adjusted until the current which flows in the secondary equals the normal full load current or any desired fraction of it. The wattmeter reading then indicates the copper losses. The secondary is then open-circuited and the normal pressure applied to the primary; the wattmeter reading in this case indicates the core loss. In this way the losses may be obtained and the efficiency calculated. In the open-circuit test, it is often convenient to use the low potential coil as primary. This method was employed in an extensive series of tests made in 1895 at the University of Wisconsin by Prof. Jackson and Mr. Ford. See "A Complete Test of Modern American Transformers of Moderate Capacities," by A. H. Ford; Engineering Series, Bulletin University of Wisconsin, Vol. 2, No. 1.

An approximate method (which we will call "Method C") for determining the drop in secondary voltage of a loaded transformer without applying a load has already been published* and has been employed in one of our largest electrical companies; but the regulation curve determined by this method (see curves C, which follow), are invariably higher than the true curve marked A, obtaining in the usual way by loading the transformer. Curves B are determined by the method to be described in this paper, and are seen to conform much more nearly to the actual regulation curves. The difference is commonly not over 1 or $\frac{2}{10}$ths of a volt. This requires but two measurements, as will now be described.

For the sake of clearness, a tranformer whose ratio is 1 to 1, and whose copper losses in primary and secondary are equal will first be assumed. To determine the regulation of a transformer by this method, the secondary is short-circuited by means of a stout copper wire and sufficient voltage applied to the primary to send any particular load-current through the coils. A wattmeter, voltmeter, and ammeter are placed in the primary circuit as shown in fig. 1 †. The reading of the wattmeter divided by the product of E.M.F. and current will give the power factor; that is, the cosine of the angle Θ of lag between the impressed E.M.F. and the current. In fig. 2 this angle is represented by N Q F. The line Q N is the voltmeter reading, being the voltage necessary to send the current corresponding to the desired load through the coils. The angle Θ is then laid off. The line, N F, is drawn perpendicular to Q F and produced to the point, E, making N M equal to $\frac{I_0}{I_1} E_1$ where I_1 is the reading of the ammeter, E_1 is the normal primary voltage, and I_0 is the magnetising current obtained by measuring the primary current when the voltage is normal and the secondary is an open circuit. With M as centre and radius M O equal to the normal primary voltage, draw an arc cutting Q F produced at O. Lay off O L equal to half Q F; draw P L perpendicular to O F and equal to N F. Join P and M, and lay off P S equal to O L. Then S M equals the voltage at the secondary terminals. The difference between S M and O M equals the voltage drop. This is, as before stated, for a transformer whose ratio of transformation is unity.



Figs. 1, 2 and 3.

For a transformer with a ratio of transformation other than unity the construction is exactly the same with the exception that the line S M must be divided by the ratio of transformation to obtain the pressure at the secondary terminals.

In this diagram M F is the total reactive drop and N F that due to magnetic leakage. Q F is the sum of the ohmic drops in the primary and secondary. In transformers of modern design this drop is about evenly distributed between the coils, O L for the primary and P S for the secondary. Q N has been called the impedance drop, being the geometrical sum of the ohmic drop and the reactive drop due to magnetic leakage.

In order to show the facility with which this method may be applied, the following numerical example for the determination of one point on the regulation curve is given. In this instance, a commercial transformer was employed with 2,500 watts capacity, transforming from 1,000 and 100 volts. The primary voltage necessary to send the desired current through the coils with the secondary short-circuited was 54 volts. The reading of the ammeter was 2·42 amperes, while that of the wattmeter was 72 watts. We have then

$$\cos \Theta = \frac{72}{54 \times 2{\cdot}42} = 0{\cdot}554; \quad \Theta = 56^\circ\ 22'.$$

The magnetising current, measured in the usual manner, was found to be 0·058 amperes. The right triangle, Q N F (fig. 3), is now constructed to convenient scale, the angle, N Q F, being made equal to 56° 22′, and the hypothenuse, Q N, equal to 54 volts. We now proceed to calculate the length of the line, N M, from the formula already given.

$$N M = E_1 \times \frac{I_0}{I_1} = 1{,}000 + \frac{0{\cdot}058}{2{\cdot}42} = 24 \text{ volts.}$$

This line is laid off as shown in the diagram, and with point, M, as a centre and radius equal to 1,000 volts, on the scale selected, an arc is drawn, cutting the line, Q F, produced at O. The length, O L, is then laid off equal to one-half Q F, and L P drawn equal and parallel to N F. The points, P and M, are then joined, and a length, P S = O L, laid off this line. S M is then the secondary E.M.F. transferred to the primary; this, on being measured, was found to be 968 volts. Dividing 968 by the ratio of transformation, we have the secondary voltage, *i.e.*, 96·8 volts. The actual voltage of the secondary found by the measurement was 96·75 volts, showing the great accuracy * of the method.

The curves given herewith show the method applied to seven transformers of various types. Transformers number (6) and (7) are small laboratory apparatus, having a large amount of magnetic leakage. They are included here to show the applicability of the method to transformers varying widely in their essential characteristics. The remaining curves are taken from well-known commercial transformers of recent types. Curves marked A show the regulation determined by actual measurement, while those marked B are determined by this method. Curves marked C are computed by the method described by Kapp, mention of which has already been made. It will be noticed that curves taken by the proposed new method (B) vary but little from those of actual measurement. In fact, the regulation can usually be obtained more accurately by this method than by loading the transformer, the results being less influenced by errors of instruments and fluctuations in the source of supply.

If the readings are taken with accuracy, *one measurement*, with short-circuited secondary, as previously described, together with the magnetising current, furnishes all the data necessary for the determination of the complete regulation of the transformer. Suppose the diagram in fig. 3 has been drawn for a load corresponding to a particular current, I′; it is required to determine the drop from any other current, I″. It may be shown (see appendix) that N F and Q F vary directly, while M N varies inversely with the current. Therefore, to determine a new point, it is simply necessary to enlarge or diminish the side of the triangle, Q N F, by multiplying each side by the ratio, $\frac{I''}{I'}$. The line, M N, is to be multiplied by the inverse ratio, *i.e.*, $\frac{I'}{I''}$. The construction then proceeds exactly as before. The angle, N Q F, remains unaltered.

The principles upon which this method is based are rational rather than empirical. The more complete theory is discussed in an appendix. What has been given above, however, is sufficient for the practical application of the method. It is pleasing to note the verification of the accuracy of the theory in the actual results obtained are shown by the curves given.

(To be continued.)

* See Kapp, "Transformers," p. 119.

† After considerable experiment it was found that this manner of connection was most satisfactory. The instruments are all placed in the primary circuit, and the secondary short-circuited as directly as possible. Where the voltage is too small to be measured by the ordinary voltmeter, an auxiliary transformer is used to step up the pressure for the voltmeter and voltage coil of the wattmeter. The reading of these instruments must, of course, be divided by the ratio of transformation of the auxiliary transformer. An approximate correction may be made in this case for the current taken by the auxiliary transformer. This is done by opening the circuit at "C" and measuring the current through the ammeter while the voltage is kept constant. This reading should be subtracted from the former reading of the ammeter to obtain a more accurate value for the current flowing in the transformer being tested.

AN IMPORTANT DECISION.†

A decision of much importance, owing to the magnitude of the interests affected and the questions of law involved, was handed down by the United States Circuit Court of Appeals for the Second Circuit on the 21st ult. in the suit brought by the Thomson-Houston Electric Company against the Hoosic Railway Company to restrain the infringement of Letters Patent No. 495,443, granted April 11th, 1893, to the administrators of Charles J. Van Depoele for travelling contact for electric railways. This is the well-known trolley patent which its owners claimed covered every practicable form of underrunning trolley, and the case was before the court on an appeal from an order of the Circuit Court granting a preliminary injunction against the defendant. The opinion, written by Judge Wallace holds, upon the authority of Miller *v.* Manufacturing Company (151 U.S. 198), that the claims sued upon are invalid, because the same invention was patented by Mr. Van Depoele in Patent No. 424,695, dated April 1st, 1890, and the order of the Circuit Court granting the preliminary injunction was reversed.

* In a long series of measurements, the difference between the observed secondary voltage and the predetermined voltage was rarely as great as 0·2 volts, and was commonly less than 0·1 volt.

† *Scientific American.*

Both of these patents originated in a single application filed by Van Depoele March 12th, 1887. The application was subsequently divided, and Patent No. 424,695, containing 35 claims, was issued on one of the divisional applications on April 1st, 1890. The other divisional application was delayed in its progress through the Patent Office by an interference, and the patent in suit, containing 16 claims, was issued thereon April 11th, 1893.

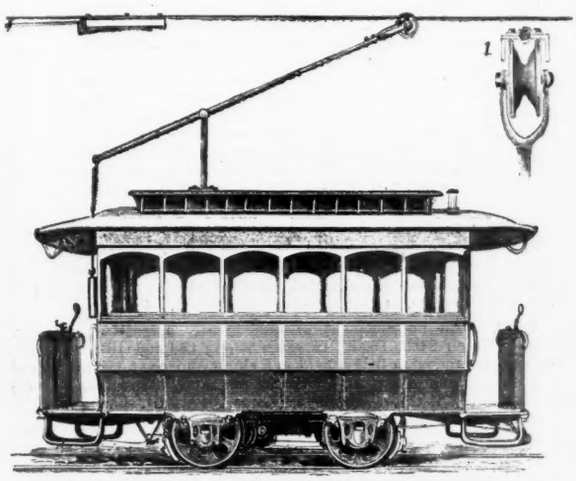
The features covered by the claims in controversy are all shown in the accompanying drawing, which is identical in both patents.

In each patent there are shown a hinged trolley arm pivotally supported on a post on the car roof, the arm carrying the contact wheel, and having at its lower end a spring with a suspended weight.

It will be observed that the construction, arrangement, and necessary operation of the trolley, the trolley arm, the post on the car, the means of securing and supporting the arm on the post, the spring and weight, are exactly the same in both patents, not only in construction and arrangement, but in necessary operation.

The earlier patent purports to claim only a certain switch plate, switching devices, and certain details "which are not essential features of the contact device itself, considered without reference to the switch," and disclaimed the contact device which forms the subject of application No. 230,649.

If the claims of this earlier patent had been clearly limited to the details which were not "essential features of the contact device itself," or to the switch plate, the right of the inventor to claim



broadly in his later patent the essential features of the contact device would have been unquestioned, but the claims were not all so limited. Among the claims of the earlier patent are the following among others that are not limited in the respects mentioned:

"15. In an electric railway the combination of a car, a conductor suspended above the line of travel of the car, a contact carrying arm pivotally supported on top of the car, and provided at its outer end with a contact roller engaging the under side of the suspended conductor, and a weighted spring at or near the inner end of the arm for maintaining said upward contact, substantially as described. . . . .

"32. In an electric railway, the combination, with an overhead conductor and a vehicle, of a trailing contact arm guided at its outer end by the overhead conductor, and movable laterally relatively to the vehicle, but having a normal centralising tendency by means of a spring or weight.

"33. In an electric railway, the combination, with an overhead conductor and a vehicle, of an intermediate contact device, consisting of an upwardly pressed trailing arm having a grooved contact wheel at its outer end, by which it is guided by the conductor, the said arm being free to swing laterally relatively to the vehicle, but tending to remain in its normal central position by means of a spring or weight."

The presence of these claims in the earlier patent alone goes far to justify the decision of Judge Wallace.

The claims of the patent, in suit of which infringement was charged, were five in number, of which we give two examples, as follows:—

"7. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, a swinging arm supported on top of the car, a contact device carried by one extremity of the arm and held thereby in contact with the under side of the electric conductor, and a tension device at or near the other end of the swinging arm for maintaining said upward contact, substantially as described.

"8. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a contact engaging the under side of the suspended conductor, and a tension spring at or near the inner end of the arm for maintaining said upward pressure contact, substantially as described. . . . .

"12. In an electric railway, the combination with a car of a post extending upward therefrom and carrying a suitable bearing, an arm or lever carrying at its outer end a suitable contact roller, and pivotally supported in said bearing, and provided at its inner end with a tension spring for pressing the outer end of the lever carrying the contact wheel upward against a suitable suspended conductor, substantially as described."

After holding that the Court should undertake to examine, and "in a sense to review collaterally" the decision in the previous suit on the same patent, brought in the district of Connecticut, against the Winchester Avenue Railway Company, in which Judge Townsend, holding that the earlier patent did not claim the same invention, sustained the patent at final hearing, from which decision no appeal was taken, Judge Wallace says:—

"The operative parts of the contact device are described in identical language in each patent, and the language of the claims aptly describes these parts. While the function of the tension device is stated with more particularity in the earlier patent, the description does not contain a word or hint by which its characteristics can be differentiated from those of the tension device of the later patent. . . . . In the later patent, as well as in the earlier, the tension device is a spring and weight, so arranged as to 'permit lateral motion by the arm,' lateral motion being afforded because, as the specification of each patent states, 'the arm is hinged, and should in most instances be pivoted to the top of the post, although a reasonable amount of looseness in the hinged joint will answer the purpose of the pivot.' In the earlier as well as in the later patent, the spring and weight 'are so arranged as to constantly tend to restore the arm to its normal central position,' and thus 'assist it to partake of the lateral movement of the car,' because this is the necessary action of the spring and weight at the short end of the arm. As described in each specification, the tension device is a spring, which is held in its proper place by the weight. . . . .

"Of course, if the claims of the earlier patent do not specify such a tension device as is described and claimed in the later, but specify one which embodies only a subordinate improvement upon it, the patents are not for the same invention. . . . . Inasmuch as the only tension device, or means for imparting upward pressure to a trolley arm, described in the specification of the later patent, is that which consists of the weight and spring as it is described in the earlier patent, the verbal differences in defining its functions in the several claims are of significance. The thing itself is the same in the claims of both patents. The spring which tends to retain the arm in its normal position is exactly the same spring, and no other than that which maintains upward contact or pressure between the contact device and the suspended conductor. If any importance is to be attached to these verbal differences, the earlier patent claims a tension device, the chief function of which is to exert a normal centralising tendency upon the arm, but which of necessity must maintain the upward pressure, while the later patent claims one, the chief function of which is to maintain upward pressure, but must of necessity also exert the normal centralising tendency. If there had been in the description anything by which it could be ascertained which of the structural features exercises one function and which the other, a different case would be presented. The matter sought to be covered by the second patent is inseparably involved in the matter embraced in the former patent, and this, under the authorities, renders the second patent void.

"It is manifest that both patents are intended to, and do secure to the patentee the same general inventions, ... although the earlier patent also covers improvements in the switches, and subordinate combinations between these devices and the elements of the principal combination. . . . .

"We are of the opinion that Claim 15 of the earlier patent describes and embraces everything of substance which is covered by Claim 7 of the patent in suit.

"We are also of opinion that claim 33 of the earlier patent specifies essentially the same combinations embraced in claims 8, 12, and 16 of the patent in suit, and that the 'spring or weight' of claim 33 is the same thing as the 'tension spring' of claims 8, 12, and 16, the 'weight' being only an alternative element."

As the facts which were before the Court on this appeal must necessarily be the same on final hearing, and as this decision does not extend the rule laid down in the much-cited and much-abused decision of the Supreme Court in Miller *v.* Manufacturing Company, it seems to be generally believed that this decision will be followed not only in this circuit, but by the Supreme Court, if the controversy should be carried there.

The patent has been in constant litigation almost since the day of its issue, and injunctions have, on the strength of Judge Townsend's decision, been granted against numerous roads using the underrunning trolley, and also against manufacturers who have furnished stands and other parts used in trolley road equipment, on the theory of contributory infringement.

As late as May 17th last, the Circuit Court of Appeals for the Sixth Circuit affirmed an order of the Circuit Court for the Northern District of Ohio, granting a preliminary injunction restraining the Ohio Brass Company, manufacturers of trolley road equipment, from infringing the claims now held to be invalid. Precisely the same question was presented to that Court, but the Court, while evidently entertaining grave doubts as to the correctness of Judge Townsend's opinion, held that the decision of a circuit court of another circuit sustaining the patent should be of controlling weight in the court below, and that on appeal the case should be reviewed merely to ascertain whether there had been any abuse of discretion in the Circuit Court. The variance between the two decisions was simply as to whether Judge Townsend's decision should be examined collaterally. Judge Taft, speaking for the Ohio Court, thought it should not, and Judge Wallace thought it should. The two decisions on the principal points at issue are therefore not inharmonious.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

18,433. "Improvements in insulating the contacts of incandescent electric lamps." W. Durant and T. W. B. Durant. Dated August 9th.

18,438. "Improved coil for electric instruments." W. Thomson. (Baron Kelvin, of Largs.) Dated August 9th.

18,457. "Improvements in electricity meters." G. Hookham. Dated August 9th.

18,464. "An insulating incandescent electric lamp holder." W. J. Bishop. Dated August 9th.

18,466. "Improvements in printing telegraph apparatus." A. J. Boult. (The Printing Telegraph News Company, United States.) Dated August 9th. (*Complete.*)

18,475. "Galvanic hand baths and foot baths, or arm baths and knee baths for directly introducing medicaments into the tissues of the human body." C. E. Schnee. Dated August 9th.

18,510. "Improvements in electrical current distributing fuse and switchboards." A. Watson. Dated August 10th.

18,548. "Improvements in the construction of electrical motors and generators." S. H. Short. Dated August 10th. (*Complete.*)

18,552. "Improvements in electric controllers for railway vehicles." S. Harris. Dated August 10th. (*Complete.*)

18,556. "Improvements in and relating to lightning arresters." The British Thomson-Houston Co., Ltd. (E. M. Hewlett, United States.) Dated August 10th. (*Complete.*)

18,560. "Improvements in or relating to cut-outs for electric installations." J. Hartig. Dated August 10th.

18,564. "Improvements in secondary batteries." E. J. Clubbe, A. W. Southey, and The Electric Motive Power Co., Ltd. Dated August 10th.

18,566. "Improvements in and connected with secondary batteries." E. J. Clubbe, A. W. Southey, and The Electric Motive Power Co., Ltd. Dated August 10th.

18,567. "Improvements in and relating to electric traction." E. J. Clubbe, A. W. Southey, and The Electric Motive Power Co., Ltd. Dated August 10th.

18,568. "Improvements in recording telegraphic receivers." H. W. Handcock and A. H. Dykes. Dated August 10th.

18,589. "Improvements in earthenware, stoneware, and other conduits for electric light and other cables." R. F. Fergusson. Dated August 11th.

18,616. "Improvements in or connected with electrolytes for primary electric batteries." R. Hurley, N. Cooney, J. Glover and G. P. Campbell. Dated August 11th.

18,628. "Improvements in portable electric primary batteries." C. H. Cole. Dated August 11th. (*Complete.*)

18,635. "Improvements in or relating to primary batteries." G. P. Tarelli. Dated August 11th.

18,644. "Improvements relating to electric telegraphy." O. J. Lodge and A. Muirhead. Dated August 11th.

18,651. "Improvements in the manufacture of paper applicable for electric insulation and other purposes." R. Atherton. Dated August 11th.

18,657. "Improvements in hand electrical firing apparatus applicable for firing ordnance grenades, mining charges and the like." C. A. McEvoy. Dated August 11th.

18,658. "Improvements in porous diaphragms and vessels for cells and accumulators." A. Nodon. Dated August 11th.

18,662. "Improvements in or relating to electric lamps." J. H. Cox. Dated August 12th.

18,666. "A new material for the manufacture of electric conduits." C. Hannay and P. J. Thom. Dated August 12th.

18,701. "An improved electric arc lamp for projection and other purposes." G. Davenport. Dated August 12th.

18,717. "Improvements in and relating to controllers for electric motors." S. H. Short. Dated August 12th. (*Complete.*)

18,718. "Improvements in and relating to electric railways and tramways." S. H. Short. Dated August 12th. (*Complete.*)

18,719. "Improvements in supports for the current collectors of electric railways and tramways with overhead conductors." Siemens Bros. & Co., Ltd. (Siemens & Halske, Germany.) Dated August 12th.

18,730. "Improvements in and relating to motor vehicles for electric railways and tramways." S. H. Short. Dated August 12th. (*Complete.*)

18,766. "The 'Flossin' light for horse trams, electric trams, buses, and motor cars." A. E. Flood and G. J. Sinclair. Dated August 13th.

18,769. "Improvements in electrical measuring instruments." G. K. B. Elphinstone and A. C. Heap. Dated August 13th.

18,776. "Improvements in automatic or electric signals for railways." W. Piscorski. Dated August 13th.

18,796. "Improvements in and connected with secondary or storage batteries." W. M. McDougall. Dated August 13th.

18,801. "Improvements in electric switches." E. W. Lloyd and L. Newitt. Dated August 13th.

18,835. "Improvements in electrolytic cell." S. Z. de Ferranti. Dated August 14th.

18,865. "A safety device for use in connection with carriages propelled by electricity." Hon. R. T. D. Brougham and W. C. Bersey. Dated August 14th.

18,871. "Improvements in electro-magnetic contact systems. W. Grunow, jun., J. A. McElroy and J. H. McElroy. Dated August 14th. (*Complete.*)

18,884. "Improvements in and relating to the manufacture of plates for electric accumulators." C. Zimmer. Dated August 14th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1896.

1,958. "Improvements in and relating to electric gas lighters and extinguishers and the like and the like." J. T. Armstrong, and C. G. G. Bramerhjelm. Dated January 28th, 1896. Relates to electrically operated gas lighters and extinguishers, in which a solenoid or electro-magnet is utilised to lift a soft iron valve contained within it, when the electro-magnet is energised by the passage of a current. Included in the circuit containing this electro-magnet is a suitable resistance situated near the burner, which the current heats to enable it to ignite the gas when the circuit is established. For regulating the opening and closing of the gas valve a permanent magnet is applied to an extension of non-magnetic material attached to the valve. 5 claims.

3,809. "Improvements in sockets and holders for incandescent electric lamps." J. F. C. Snell, A. H. Francis, R. S. J. Spilsbury. Dated February 19th, 1896. Two metallic contact springs are arranged at the two extremes of a diameter of the holder and socket. The casing is provided with a cross bridge piece passing between and completely separating the contacts. The socket consists of a collar of insulating material, and having in its walls at two diametrically opposite points slots through each of which passes and is secured on the outer side of the collar a metallic strip having part near its base. The lamp globe is inserted and its contact wires from the filament connected to each side slip, and the collar is filled up solid with metallic filling. 2 claims.

4,937. "Improvements in plates, grids, or supports for the elements of secondary batteries." E. Clark, W. Clark, F. King. Dated March 4th, 1896. Grids for secondary batteries have their sides formed of lattice connected by ribs and with a diaphragm zig-zag with the sides. Other forms are mentioned. 4 claims.

6,510. "An improvement in electric arc lamps." J. Brockie. Dated March 24th, 1896. In cases where the rod that feeds the carbons is tapered, a ball is held in a sloping space at the one side of a sleeve, which partly embraces the rod and is suspended by the lever worked by the regulating solenoids. 4 claims.

23,992. "A new system for electrical propulsion for cycles and common road and other vehicles." R. A. Marples. Dated October 28th, 1896. The cycles run on an ordinary track. Two overhead conductors are employed connected to the negative and positive poles of a dynamo, the circuit being made between them by a moving trolley carrying flexible wires leading to the motor of an electrically propelled cycle. 6 claims.

25,234. "Multiple fuse block and switch." E. H. Montgomery and M. Thommes. Dated November 10th, 1896. The invention relates to improvements in fuse blocks and switches its object being to provide a combined multiple fuse block and switch adapted to be placed one in each loop so as to dispense with other fuse blocks in the system and at the same time furnish an efficient switch. The base is circular in form having a central opening to receive the spindle which carries the handle arranged in the centre of the base, and surrounding the hole is the annular contact ring to which the line wire is connected. Near the outer edge of the base is arranged the upwardly inclined curved flat-spring connected similarly to the line wire. A fuse block has on its outer face an annular ring adapted to bear upon the ring when in its normal position. This is secured upon the base by means of the spindle and spring. A centrally slotted opening is adapted to receive the flattened portion of the spindle so as to turn with the same. The underside of the plug near the outer edge is cut away into a series of ratchet teeth. Upon the face of each alternate incline is arranged the contact strip, the inner end of which is carried up through a slit in the block, the end being bent over on the top of the block. Each strip is connected with the annular ring by means of the fuse, secured to it by means of a screw, the other end being bound under the head of the screw which extends downwards through the block into the ring the body of the fuse lying in a groove upon the face of the block. 3 claims.

26,846. "Improvements in electric bell pushes or knobs." T. Sanders. Dated November 26th, 1896. The invention relates to electric bell pushes or knobs by which the twisting off or disconnection of the button from the circuit wire which often happens with the round push as at present constructed is prevented. To overcome the difficulty the button is formed which is pressed when the electric bell is rung, either square, oval, oblong, or any shape which will prevent the same from turning round in the socket hole. 1 claim.

27,047. "Improvements in or connected with electric cable disconnecting boxes." G. H. Nisbett, and W. Boby. Dated November 28th, 1896. The invention refers to disconnecting boxes used in connection with electric cables. In the disconnecting box is an insulating shield adapted to be left in place, covering the connections when they are made, and to be removed with such connections, when they are removed, thus avoiding risk to the operator. 4 claims.